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Knowledge Enhanced Financial Advisory Services

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The Faculty of Economics, Business Administration and Information Technology of the University of Zurich hereby authorizes the printing of this dissertation, without indicating an opinion of the views expressed in the work.

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Chairwoman of the Doctoral Board: Prof. Dr. Elaine M. Huang

To Peter Heinrich Senior

Abstract

Ever-more complex financial products and investment opportunities demand that clients have a solid understanding of financial concepts if they are to make informed decisions. However, this is seldom the case, and the consequences of uninformed decision-making have been widely described in both the scientific literature as well as in public media. Interventions in the form of providing more documentation on products have been ineffective (Chater *et al.*, 2010). The same seems to hold for efforts in schools to foster financial literacy, as it is (1) unclear what knowledge comprises effective decision help in an upcoming advisory encounter, and (2) there might be a very long time distance between the learning and the application in a real advisory encounter situation (Fernandes *et al.*, 2014).

In this dissertation, I therefore describe a way of client education that can be directly applied in the service encounter itself. The educational concept is based on experiential learning theory (Kolb, 1984) as a general framework, and is specifically rooted in open-ended learning environments (Hannafin, 1994) as well as the concept of micro-worlds (Rieber, 1992). Interactive, computer-based simulations are utilized to explain the relevant concepts at the time they are needed for making decisions. Embedded in a design science research framework, this dissertation contributes design rationales for both the technical systems required for this consumer education style as well as for the processes of how these tools can be embedded in the service encounter. In several consecutive build/evaluate cycles, design principles are instantiated and evaluated in realistic laboratory evaluations. Besides the focus on the educational aspects, light has also been shed on the social implications of introducing technology into these settings. This dissertation contributes

insights on how technical systems, advisory processes, and the environment of an encounter must be designed in order to fulfill its purpose of transferring relevant knowledge without disturbing the critical social relationship between client and advisor. With our evaluations, we were able to demonstrate that client education with a significant client knowledge increase is possible directly in the encounter itself in a *just-in-time* and *on-demand* manner without disturbing the social relationship in any unacceptable way. Besides its contributions to the scientific knowledge base, this dissertation also seeks to aid practitioners in building the systems that will enhance the financial services of tomorrow.

Zusammenfassung

Die steigende Komplexität von Finanzprodukten sowie die zahlreichen Investitionsmöglichkeiten setzen ein solides Finanzwissen seitens der Kunden voraus um informierte Entscheidungen treffen zu können. Dies ist jedoch selten der Fall und so wurden die Auswirkungen von uninformierten Investitionsentscheidungen breit in der wissenschaftlichen Literatur sowie in der Presse diskutiert. Versuche, dem Kunden im Beratungsgespräch mehr Dokumentation zu den Produkten zur Verfügung zu stellen haben sich nicht als nützlich erweisen können (Chater *et al.*, 2010). Das Gleiche scheint für die Bestrebungen zuzutreffen, Finanzwissen in den Schulen zu vermitteln: In Bezug auf ein späteres Beratungsgespräch ist ersten unklar, welches Wissen dann genau benötigt wird und zweitens liegt die Vermittlung des Wissens und die Anwendung dessen gegebenenfalls zeitlich sehr weit auseinander und vieles ist bereits wieder vergessen worden (Fernandes *et al.*, 2014).

In dieser Dissertation wird daher ein Weg aufgezeigt das relevante Finanzwissen direkt im Beratungsgespräch aufzubauen. Das didaktische Konzept basiert hierbei im Allgemeinen auf der Experiential-Learning-Theory (Kolb, 1984) und im Speziellen auf dem Einsatz von Open-Ended-Learning-Environments (Hannafin, 1994) sowie dem Konzept von Microworlds (Rieber, 1992). Interaktive, computerbasierte Simulationen bilden hierbei den Kern um den Kunden die entscheidungsrelevanten Konzepte genau dann zu vermitteln, wenn diese unmittelbar für das Fällen von Entscheidungen gebraucht werden. Im Rahmen eines Design-Research-Projektes wurden hierbei Gestaltungsprinzipien sowohl für die technischen Systeme als auch für die Prozesse, welche definieren, wie sich diese Werkzeuge in Beratungsgespräche einbinden lassen, erarbeitet. In mehreren

aufeinanderfolgenden Entwurfs- und Evaluationszyklen wurden diese Gestaltungsprinzipien instanziiert und in realitätsnahen Szenarien evaluiert.

Neben dem Fokus auf den Wissenstransfer-Aspekt wurden auch die Implikationen auf das soziale Setting, die durch die Einführung von Technologie entstehen, untersucht. Der Beitrag dieser Dissertation liegt in dem kombinierten Designwissen über Werkzeuge, Beratungsprozesse und der Gestaltung der Beratungs-Umgebung um einen Transfer von relevantem Wissen zu ermöglichen ohne gleichzeitig das empfindliche soziale Gefüge zwischen Berater und Kunde zu stören.

Mit Hilfe der Evaluationen konnten wir zeigen, dass mittels geeigneten Werkzeugen, Prozessen und Umgebungen eine signifikante Erhöhung von Finanzwissen beim Kunden grundsätzlich auch während der Beratung „Just-In-Time" und „On-Demand" möglich ist ohne das fragile soziale Gefüge einer Beratungssituation in unakzeptabler Weise zu verändern.

Neben den Beiträgen zur wissenschaftlichen Wissensbasis soll diese Arbeit auch hilfreich für die Praktiker sein, welche zukünftige Beratungssysteme gestalten um die Finanzberatungen von morgen gewinnbringend zu unterstützen.

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PART I – SYNOPSIS

1.1 Introduction

Financial advisory services are an important sales vehicle for financial service providers. Despite all the negative media coverage over the past decade, people still seek advice at these service encounters in over 70% prior to their investment decisions (Hung *et al.*, 2008; Jansen & Hackethal, 2008). However, many investment decisions made during these encounters later turn out to be suboptimal; according to some source, the annual loss in national wealth is in the tens of billion euro in Germany alone (Oehler & Kohlert, 2009; Oehler & Höfer, 2012). Therefore, it seems a legitimate question to ask why this could not be changed over decades. On the one hand, this might partially be attributable to the unpredictable nature of the financial market; hence, some losses may actually be cases of 'bad luck'. On the other hand, financial advisory services are often offered by dependent advisors working for the financial service provider (FSP) and towards their own interests and goals (Oehler & Kohlert, 2009). While the first explanation is inevitable and an inherent given, the latter is much more interesting from a research perspective. The problem is that both parties (clients and advisors) seek to maximize their earnings. While this may not be a problem per se, in these settings, is likely to reach harmful levels if advisors are (monetarily) incentivized to sell certain products or certain amounts of them and if the clients are unable to verify the suitability of the offered products (Kohlert & Oehler, 2009). Often it is a question of both! Especially the latter is very likely since, most often, these are 'expert-layperson' encounters (Schmidt-Rauch & Nussbaumer, 2011). Thus, diverging goals exist, in combination with knowledge asymmetries. Given that the advisor is the expert, he can (and likely will) use his knowledge to strive towards his goals. In the literature, this is described as *principal-agent conflict* (Eisenhardt, 1989; Novak, 2009).

At a first glance, the *expert-layperson* aspect also seems to be inherently given, since an expert would not seek help in such an encounter but would rather solve the problems by himself. However, this assumption neglects the fact that these services can indeed change an advised person's state of mind. Decisions (whether good or bad) can be made after the advisory service that were impossible for an individual to make before. In a poor service, this decision-making process is subject only to the advisor and is accepted by the client solely based on a questionable trust relationship (Oehler & Kohlert, 2009). A good service, on the other hand, would seek to foster *informed decision-making* (Gafni *et al.*, 1998) – thus getting a client to understand what they are deciding upon. There are many reasons for fostering informed decision-making. For one, it is assumed that clients have difficulties expressing their current situations and problems in ways advisors can understand them. Literature describes this problem as *sticky information* (Von Hippel, 1994; Novak, 2009). Thus, one would assume that the results of an advisory service would be much better if the clients would be able to evaluate the advice provided in the context of their own situation by themselves. For FSPs, this would also be beneficial, as one would expect higher customer loyalty (Bell & Eisingerich, 2007), and thus also higher customer retention in times of financial crisis or other market-induced losses not directly attributable to failures in the advisory service. Given the many cases of advice-giving failures, also legislators have engaged and sought to intervene in this process. Today's normative regulations demand enlightening a client in a way that he fully understands his buying decisions and the associated consequences (i.e. risks) (WpHG, 2011). However, interestingly, and despite these specific goals, very little has changed. Still a work practice of uninformed decision-making exists that resembles the traditional *advice giving and taking model* (Jungermann, 1999; Oehler & Kohlert, 2009).

Hence the long-term objective of my research is to transform these services towards encounters of informed decision-making.

However, my aim here is *not* to make the clients' experts, but to educate them *enough* to understand the various options they can decide upon, to enable them to make informed decisions. But how does one quantify 'enough'? This has both qualitative aspects (e.g. what knowledge is necessary) and quantitative aspects (how much of it).

Several authors consider true informed decision-making (having 'all' knowledge required) to be unachievable (Jungermann, 1999; Kohlert & Oehler, 2009; Oehler & Kohlert, 2009). Prior attempts to support at least some acquisition of knowledge by providing extended written documentation have failed (Chater *et al.*, 2010). However, there seems to be a consensus that the service encounter itself is the recommended point in the service process to educate a client (Chater *et al.*, 2010; Bradbury *et al.*, 2014; Fernandes *et al.*, 2014).

Thus, at a general level, the overarching research question is:
RQ1: *How can financial advisory services be supported to foster client education?*

1.2 Problem Statement and Detailed Research Questions

It might be an illusory goal to have present all the knowledge required for applying decision analysis to decide upon financial investments (Jungermann, 1999), since the decision space is far too complex, sometimes even for the experts. However, when people must make decisions in complex environments, they often apply 'causal knowledge' to facilitate that process (Garcia-Retamero & Hoffrage, 2006). This can be simple heuristics about the environments that can provide 'causal texture' (Garcia-Retamero & Hoffrage, 2006). Thus, equipping a client with a useful 'causal texture' of the environment he faces in his situation could be a sufficient goal.
The central problem of this causal texture, in the case of this scenario, is that it is fairly tacit and is conceptually different from simple declarative knowledge that could easily be transported in written or narrative form. In fact, it is so tacit that even if all mechanisms of an environment are properly defined and understood, its causal texture may still stay hidden. For instance:

Consider a simple coin-flipping game: *If heads, you win 5% of your pool, if tails, you lose 5%. The game is always played twice, and the wins and losses are invested recurrently.*

This looks like a fair game, since upon first glance, it suggests a 50% chance of winning or losing money. And in fact the expected value of the return is always 0%. But what are the odds of losing money if you only have the opportunity of playing once (you cannot repeat an investment)? The math says that even if it is a fair game with an expected value of still 0%, three out of four players will have lost money, and one lucky one will have gained so much money that he compensates for the losses of the others on average. Arguably, this would have not been obvious to an undiscerning person, although the rules were presented clearly and understandably. This issue could have been resolved beforehand by exhaustively teaching a player the odds of asymmetrical probability distributions resulting from compound interest calculus in random walks. But this seems impractical and too labor intensive, even for this simple example, not to mention the odds of educating clients in this manner during an advisory service session. These explanations are also difficult not just owing to their complexity and the missing previous knowledge on the client's side, but owing to the time constraints during these services and the risk of cognitive overload (Oehler & Kohlert, 2009). In the example, a far simpler and more useful 'causal texture' could be: *If risks are involved, chances are above 50% that the individual's actual return is below the expected return*.

This was just an example but that fact becomes relevant in almost any advisory service encounter in which risky products are discussed, because for instance "10.52% expected return" has a completely different meaning if a person knows that, given a substantial risk (i.e. 20% variance), he has a 50% chance of having less than 8.3% annual return (median of the return), and that his personal return will most likely be around 4.08% only (modus of the return) on a 30 year investment period (Spremann, 2002).

We call this problem the *tacit causal texture problem*.

There may be many approaches to answer this question, but this dissertation covers the approach of designing specific IT artifacts to support clients and advisors during the service encounter. For example, IT has been successfully utilized to increase the perceived transparency of financial service encounters (Nussbaumer, 2012). But while transparency is not sufficient for decision-making to be considered as informed, it is a required precondition and a valuable first step towards more informed decision-making. Only when the service provides transparent access to necessary information can informed decision-making take place. However, access to information alone does not guarantee that the content is properly understood by a client. This dissertation seeks to answer a more refined set of research questions:

RQ1.1: *How can IT artifacts be designed to foster knowledge transfer in financial service encounters?*

But a pure design solution for a technical artifact would be insufficient. Given the complexity of client-advisor social interactions, it seems unrealistic to solely rely on a *technological imperative* (Markus & Robey, 1988); instead, one should take an *emergent perspective* (Markus & Robey, 1988) of how a redesigned encounter, with technological support, will influence participants' behavior and the outcomes of advisory services. While it can be argued that making these causal textures accessible to a client involves some form of learning, this is difficult to establish in these services, for various reasons: First, these encounters are not intended to be educational, they are intended to provide advice (client perspective) and to sell products (FSP perspective). Apparently, the product sales view seems to be accepted also from the side of the clients. Instead of enforcing the advisors to explain the relevant information to them in an understandable manner, they often engage in a role-play like interaction called 'as if behavior' (Jungermann & Belting, 2004): Clients behave as if they understand the information presented and advisors behave as if they actually believe this. Hence existing knowledge gaps do not get closed. This could be attributed in part to the perceived inability to fix the problem and the demand to make the deal (from the advisor's perspective),

but also to the desire to not expose their incompetency (from a client's perspective) (see Jungermann & Belting, 2004; Kohlert & Oehler, 2009). An alternative explanation could also be that clients do not even perceive their knowledge as inadequate, as they cannot assess it themselves (Kruger & Dunning, 1999), which makes an intervention even harder, because it would be socially unacceptable to tell a client that s/he is incompetent. The same holds true for advisors. Enforcing a fixed process, ensuring that certain steps (i.e. learning activities) have been completed, would be an aspect of the acceptance of any proposed solution, as previous experimental evaluations of technology-supported service encounters have revealed (P. Nussbaumer *et al.*, 2012).
Thus, a practicable way of integrating technology to help detect and close existing knowledge gaps in an 'non-enforcing' way must be found to retain the given (end established) social setting anticipated from clients and advisors for these kind of services.

We call this problem the *critical social setting problem.*

Thus, the following research question must also be answered:
RQ1.2: *How can the advisory service (as a mixture of tools, processes, and environment) be designed to make the use of IT tools successful while retaining the traditional and anticipated social setting?*

While RQ1.1 directly addresses the aforementioned goal of fostering consumer education, RQ1.2 addresses the frame conditions that are necessary to successfully implement technology in these settings. Hence our core working hypothesis is that IT-supported advisory service encounters can be designed to foster learning by explicating the tacit causal texture and retaining a social setting comparable to traditional advisory service encounters.

1.3 Methodology

I answer these research questions by applying the methodology of design science research (DSR) to address the problems. "The objective of design-science research is to develop technology-based solution to important and relevant business problems" (Hevner *et al.*, 2004). This dissertation reports on several consecutive *build-evaluate cycles* (Hevner, 2007) where we design technological artifacts (as well as the processes concerning how these are to be used) and evaluate them with respect to the design objectives deduced from the afore-mentioned problems. In contrast to other IS research disciplines (e.g. behavioral research), design research focuses on utility rather than truth (Winter, 2008). In this case, the evaluations seek to show that the artifact can address the problems in a more "efficient and effective way" (Hevner *et al.*, 2004). Depending on the design solution's maturity, we either did a feasibility study, where the artifact serves as a "proof-of-concept prototype" (Nunamaker & Briggs, 2012), or at later stages we performed a deeper assessment of the artifacts in order to shed light on the artifact's specific utility with respect to the specified design objective ("proof-of-value prototype") (Nunamaker & Briggs, 2012). In this dissertation, I present both evaluation types and prototype types.

This DSR project's general orientation is explicated in Table 1. It shows how the generic guidelines for DSR projects of Hevner (Hevner *et al.*, 2004) are instantiated in this research project:

Table 1: Overview of how the Generic DSR Research Guidelines (Hevner *et al.*, 2004) were Applied

Guideline	**Application throughout this dissertation**
Design as an artifact	The core design artifacts are IT-based systems to support the client and the advisor throughout the service encounter. Besides this technological artifact, the process as well as the environment are also key design artifacts.
Problem relevance	The problem of insufficient financial client knowledge in the advice-giving process is well described in literature (i.e. (Bradbury *et al.*, 2014; Fernandes *et al.*, 2014; Jungermann, 1999; Oehler & Kohlert, 2009; Kohlert & Oehler, 2009)). The problem is very relevant, owing to the losses that result from making poor investment decisions (Oehler & Höfer, 2012).
Design evaluation	All evaluations presented in this dissertation are experimental. In laboratory settings, unsupported (traditional) service encounters are directly compared with their IT-supported counterparts. Whenever feasible, all evaluations were carried out as within-subject evaluations for both clients and advisors.
Research contributions	Our main contributions are design principles for both the IT systems as well as the services themselves. Theses design principles are multigrounded (Goldkuhl, 2004) by empirical evidence, their constructs, the value and – wherever possible – also by explanation.
Research rigor	As our design artifacts are clearly "components of a human-machine problem-solving system" (Hevner *et al.*, 2004) and therefore rely on the environment to function correctly, excessive formalism can hardly be applied without lessening the relevance (Hevner *et al.*, 2004). Hence the focus of the rigor is on the construction part (by drawing from the existing knowledge base (Hevner *et al.*, 2004)) as well as on the evaluation, using experimental methods ("comparability, subject selection, training, time and tasks" (Hevner *et al.*, 2004)).
Design as a search process	The 'search process' is driven by subsequent design-evaluate cycles (Hevner, 2007; Hevner *et al.*, 2004), with the

	redesigned artifacts taking into account the gained knowledge from the evaluations.
Communication of research	We emphasized communicating design knowledge from the early stages of the project, too. To account for the (sometimes) nascent nature of this design knowledge, we derived a publication framework (part of this dissertation (Heinrich & Schwabe, 2014)) for communicating nascent design knowledge based on an existing publication framework (Gregor & Hevner, 2013).

Each design-evaluate iteration was carried out as a separate subproject following the basic structure of a DSR project (Peffers *et al.*, 2007). Peffers et al. (2007) proposed a process comprising these steps: (1) problem identification, (2) objectives of a solution, (3) design and development, (4) demonstration, (5) evaluation and (6) communication. Table 2 shows how we have applied this process to our (sub)projects. Each subproject and its result is covered by one paper, incorporating this structure:

Table 2: Overview of how the Generic Structure of DSR Projects (Peffers *et al.*, 2007) was Applied to the Build-evaluate Cycles

Process step	**Application in (sub)project**
Problem identification	For each subproject, a precise problem statement is formulated. The relevant constructs are explained. The overall relevance of the design problem is given by existing literature or insights from prior evaluations. The identified problems provide the basis for the formulated research questions.
Objectives of a solution	For every design iteration, clear solution objectives are defined. It is argued how the fulfillment of the objectives is measureable.
Design and development	Existing knowledge from the knowledge bases is applied during artifact construction. Also, insights gained from previous design iterations and knowledge gained from field work were incorporated during the artifact's design. Incorporating existing knowledge into design decisions helps to make the design process more rigorous and comprehensible. However, designing artifacts remains a creative process that cannot be completely replaced by deductive reasoning. A design that is solely explained by existing knowledge would be pure "routine design" (Gregor & Hevner, 2013) and would not provide any research opportunities.

Demonstration	An exemplar instantiation of the artifact is presented. Owing to publication restraints, this presentation is restricted to screenshots and explanations of how the artifact works and how the design principles from the prior steps were applied.
Evaluation	The artifact instantiation is evaluated in a realistic setting. At this stage, we can only demonstrate utility in laboratory settings. The results of these evaluations can be used in two ways: (1) They serves as a confirmatory evaluation of the design principles and (2) They provide further insights through explorative analysis (Briggs & Schwabe, 2011). This allows for further refining or creating additional design principles (Gregor *et al.*, 2013). A proof-of-use would be the next logical step, but would require the artifact to be used in the field outside the laboratory (Briggs & Schwabe, 2011).
Communication	The communication to the scientific community is provided by the publications. The knowledge dissipation to practice happens through close collaboration with the field (FSPs) in every phase of the projects. Our publications contribute the design rational represented by multigrounded design principles.

1.4 Contributions of this Dissertation

I answer the research questions RQ1.1 (*How can IT artifacts be designed to foster knowledge transfer in financial service encounters?*) and RQ1.2 (*How can the advisory service (as a mixture of tools, processes, and environment) be designed to make the use of IT tools successful while retaining the traditional and anticipated social setting?*) within two publications each. The first two publications of this dissertation address the problem of tacit causal texture by designing prototype IT systems that are evaluated in a laboratory setting. These two papers' primary contribution is the design rationale in the form of design principles. While the first evaluation was a proof-of-concept evaluation in a tightly controlled environment, the latter was conducted with real financial advisors to demonstrate the artifacts' utility. These two publications constitute two consecutive build-evaluate cycles.

The next two publications address the critical social setting problem. In *"Enabling Relationship Building in Tabletop-supported Advisory Settings,"* (Heinrich, Kilic, Aschoff, *et al.*, 2014) we report on a failed proof-of-concept design that accidentally hampered relationship building. This became evident during the evaluation. We treated this failure as an opportunity to gain insights into the reasons why and how the relationships were disturbed by the artifact. We found strong indications that a major obstacle to relationship building was that the participants were overly focused on the artifact and completely lost sight of the other person. To address this, we derived design guidelines to (re-)enable relationship-building when using IT artifacts. We evaluated the artifact's utility with respect to the relationship building aspect and could report on a successful second evaluation cycle with the adapted system. The fourth publication is also explorative and a proof-of-concept. We sought to better support the needs elicitation activities of the advisory encounter when it became apparent that the participants followed a strict process while using the artifact, although the artifact was designed with the intention to provide a maximum of procedural freedom. However, as it turned out, the participants interpreted the content presentation structure as a pattern they used as a process and as an indicator of their advisory session's progress. Sometimes, this went as far as both client and advisors engaging in activities they perceived to be unnecessary but which they did for the sake of task completion. Both of these findings (hampered relationship building and coercing into completeness) are also very relevant for client education activities. While the first finding is to be avoided strictly to retain the social setting, the second finding can provide an opportunity to deliberately but gently control the process of learning activities without enforcing it directly within the software, as visually represented process structures are a thread to user acceptance in these settings (Nussbaumer & Matter, 2011). However, at present, this is an explorative finding from a pure proof-of-concept prototype, and its utility in controlling the process of learning activities must be demonstrated in subsequent research.

As described, the design knowledge contributed in this dissertation's publications are at different maturity levels. While some design knowledge is sufficiently understood to anticipate a certain value, other design rationales are at a pure conceptual and proof-of-concept stage. This was a challenge for the publication activities, since known publication frameworks (e.g. Gregor & Hevner, 2013) did not provide guidance on how to present design knowledge at different maturity levels. Thus, in a fifth publication, we present a framework that guides the structure of the individual publications to deal with different design knowledge maturity levels.

Figure 1 provides an overview of these publications and how they relate to each other. The contributions of the afore-mentioned publication is described in some detail in the following subsections.

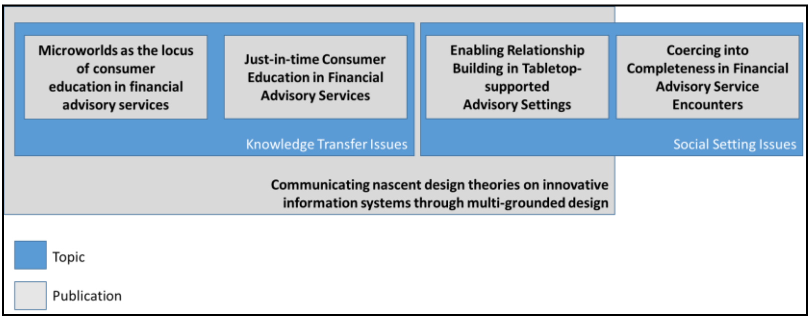

Figure 1: Conceptual Associations between the Publications

1.4.1 Microworlds as the Locus of Consumer Education in Financial Advisory Services (Heinrich, Kilic & Schwabe, 2014)

In this publication, we suggest using microworlds as a tool to foster knowledge transfer in financial advisory service settings. Microworlds (Rieber, 1992) are a particular form of open-ended learning environment (Hannafin, 1994) that "promote cognitive engagement through learner centered activities, concrete manipulations and guided exploration" (Hannafin, 1994). In our design, these microworlds are simulations of financial models. We contribute detailed design principles on how these microworlds can be constructed to support this mode of education with a focus on financial service encounters. Using these methods of education is an exaptation of known educational methods to financial service encounters. As these encounters are not primarily designed for educational purposes (as school or university lectures are), it was unknown whether or not this style of education would work under these conditions. Our design focuses on *reflection-in-action* (Land & Hannafin, 1996) as a swift way to acquire causal knowledge while interacting with the system. In this form of interaction, the client alters some input parameters of the simulation while simultaneously observing changes to the effect. An evaluation was conducted to demonstrate this concept's feasibility. In a tightly controlled laboratory setting, we simulated an advisory service encounter. For the purpose of minimizing external influences not traceable to the artifact, the explanations were provided by a video recording of a financial expert explaining the financial topics. We compared explanations using pen and paper (current work practice) and usage of microworlds. This was performed for two learning units alternately.

Based on the evaluation results, we could report a partial success. For one learning unit, the microworld-based approach significantly outperformed its traditional counterpart, while for the other learning unit, it made no significant difference. We attribute this different behavior to some design flaws in the system for the second learning unit. On the one hand, we argue that we might have accidentally overloaded the client's visual channel by offering a too complex visualization of the client's input to the simulation.

Thereby, we argue that effective learning through reflection-in-action was hampered. On the other hand, we argued that the causal model driving the simulation was too complex, as some causal relationships were only perceptible under certain settings of the independent variables defining the simulation's outcome.

1.4.2 Just-in-time Consumer Education in Financial Advisory Services (Heinrich & Schwabe, 2015)

Based on the results of the previously described proof-of-concept iteration, we designed a new system and evaluated its value in a more realistic setting with real financial advisors from a major Swiss bank. This setting also enabled us to study design aspects of how these learning episodes can be integrated into the service. To guide the new design, we first conducted a small field study to assess the current consumer education work practice within this financial institution. We found overly heterogeneous ways of performing client education, which endanger client education success. Based on interviews and focus groups conducted with advisors and executives, we conclude that consumer education today suffers from heterogeneous processes, tools, assessments, and goals, which make successful knowledge transfer subject to the individualities of the specific advisors. We address the overall problem of heterogeneity by designing an integrated learning model coined *education interleaved decision-making*, which we support by specially tailored IT tools. In this model, each relevant decision is preceded by a learning activity to teach the 'mechanics' of the forthcoming decision. We contribute design principles on how these systems can be built so as to be integrated into the service. Besides the design of the *education interleaved decision-making* process, we stipulate that the learning environments should feature learning methods based on interactions to enable the advisor assessing the learning outcome and knowledge levels along the way. We further argue that the supportive system should only offer a single learning tool for a concept, to remove the necessity of selecting one that matches the client. However, this requires that the tool is suitable for every client and dynamically adapts to his current

knowledge level. To achieve this we make use of the concept of *open-ended learning environments* (Hannafin, 1994), where the client "determines what, when, and how learning will occur" (Land & Hannafin, 1996).
We instantiate our design principles within a system to support the whole advisory process and add two exemplar learning elements for complex yet relevant topics to foster informed decision-making. In a laboratory evaluation, we tested the system with 12 experienced financial advisors from a large Swiss bank and 36 students in the role of clients. Knowledge levels were assessed before and after the treatments with a set of multiple-choice questions. Each participant received two treatments, one with the newly designed system and one traditional (pen and paper) encounter. We were able to show that the participants were on average significantly better when the content was taught supported by our system compared to the traditional form of explanation.

1.4.3 Enabling Relationship Building in Tabletop-supported Advisory Settings (Heinrich, Kilic, Aschoff & Schwabe, 2014)

The problem of a fragile social setting became apparent during the evaluation of an early prototype back in 2010. We implemented a system to support the advisory process on a multitouch tabletop computer system. We evaluated the system with four real financial advisors and 12 clients. The evaluation revealed that the design was flawed, as 10 out of 12 participants mentioned that the system negatively impacted their relationship with the advisor. Some of them reported that they felt that the focus was on the computer system rather than on them. Others reported on a triangular relationship between the advisor, the system, and themselves. This problem has been long been known from Computer-Supported-Collaborative-Work (CSCW) research. Inappropriately designed IT systems can hamper communication (Haller *et al.*, 2005). However, the use of tabletop IT systems was thought to be an appropriate solution to this problem by enabling one to focus on communication (Scott *et al.*, 2003). The contribution in this paper is twofold: (1) we contribute the phenomenon of fragile relationship building when using technology that was thought to provide enough support for this, and (2) we provide design guidelines on how relationship building can be (re)enabled when supporting such encounter settings with computer systems. The paper is structured around a two-cycle DSR process of subsequently building and evaluating two artifacts. We report on the first cycle as a 'naïve' design approach. Its evaluation is used to describe the phenomenon and identify the problems related to it. Besides the verbal reports of the participants during the evaluation we use *face-gaze* as an operationalization of relationship building. We conclude that, in contrast to existing literature, relationship building is not only hampered by the aspects of an environment (the technology used), but also by other physical parameters such as body positioning around a table and the software system's design. For each of these aspects, we contribute design guidelines of how such systems and environments can be constructed to enable relationship building. In a subsequent evaluation, we demonstrated that a design that follows our design principles, can retain the *face-gaze* level to an acceptable level. Later evaluations have shown that the total *face-gaze* duration during the use of our prototype is comparable to conventional pen and paper settings.

1.4.4 Coercing into Completeness in Financial Advisory Service Encounters (Kilic, Heinrich & Schwabe, 2015)

While IT can influence the social setting and hamper relationship building, it has also the potential to accidentally influence established processes. In this publication, we describe a phenomenon we call *coercing into completeness*. Sometimes it is desirable that people follow a set processes for reasons of controlling the service delivery's quality. However, past research has found that too much restrictions will lead to an acceptance problem, rendering meaningless the whole approach of supporting advisory encounters with IT (Nussbaumer & Matter, 2011). However, as we report in this publication, a new system we designed with the intention to deliver broad freedom was misinterpreted by its users and again led to fixed process structures. As a primary design element, a mindmap-like structure was used to support the client profiling activities during the encounter. Apparently, this content structure was misinterpreted as a progress indicator (how many topics are left uncovered). While the phenomenon did not manifest as severely as before – most participants did not mention this aspect by themselves – it still had a big influence on the conversation structures between clients and advisors. We provide a detailed exploration of the phenomenon and show how it manifests in our financial advisory situations. We argue that predefined content structures were the root cause of this phenomenon, which galvanized people into to a mode of coercing into working of each element of the structure to reach a state of completion. Furthermore, these structures were also interpreted as a template for an advisory process to follow, as we observed the majority of the advisors following a linear and clockwise pattern of addressing the given structure (mindmap-like star topology). This also had severe influences on the communication patterns between clients and advisors. While in traditional settings, the conversation was characterized by long conversation sequences (consecutive, topic-related question answer episodes), the conversation sequences of IT-supported service encounters tended to be much shorter, often containing only a single question answer episode, followed by an abrupt change in topic (to the next topic provided by the structure). However, structures can and should generally not be avoided, as they can also benefit the service encounter quality, such as helping to diminish information asymmetries (P. Nussbaumer *et al.*, 2012). Thus, we conclude that any real-world design will have to make a careful tradeoff between the benefits and dangers of predefined content structures in future systems.

1.4.5 Communicating Nascent Design Theories on Innovative Information Systems (Heinrich & Schwabe, 2014)

In *Communicating Nascent Design Theories on Innovative Information Systems*, we explain the structure of the first three publications. As described in the introduction, this dissertation project contains *proof-of-concept* as well as *proof-*

of-value prototypes and evaluations, sometimes at the same time, where one proof-of-concept evaluation provided the (explorative) basis for later (confirmative) proof-of-value evaluations. This led to several problems in publishing the insights from the DSR activities. Not only did the evaluation have different goals, but the knowledge gained also materialized at different maturity levels. Some of the design rationales were derived from literature or prior insights from past build-evaluate cycles, while others were intentionally made but originated from creative design activities. Hence, design knowledge that constitutes the design rationale of one build-evaluate iteration exists simultaneously at different maturity levels.

In this publication, we present a framework to capture the state of design knowledge at an arbitrary state of the project and present it in a uniform representation. We use the notion of multigrounded design principles as a way to transport design knowledge in a concise form. By applying multiple grounding strategies (value grounding, conceptual grounding, explanatory grounding, and empirical grounding) (Goldkuhl, 2004), we are able to express the rigor level and the maturity level separately for each design principle. This enabled us to present principles of different maturity levels in one publication. Through conceptual grounding and value grounding, the design principles are connected to constructs that are supposed to induce a certain value, namely the achievement of the core design objective, the design intervention addresses. Based on the literature, the design principle's effect is explained (if appropriate theoretical knowledge is available). The principles are empirically grounded through evaluation of the system.

We see this as preparatory work towards building a design theory. In contrast to a unified theory for designing knowledge enhanced service encounters, this dissertation offers several in-depth design insights covering particular design objectives relevant to the design of these encounters. A design theory would aggregate these particular design insights into one cohesive construct. Gregor et al. (2007) propose a component framework of what an information system design theory (ISDT) should consist of, listing eight components: (1) purpose and scope, (2) constructs, (3) principles of form and function, (4) artifact mutability, (5) testable propositions, (6) justificatory knowledge, (7) principles of implementation, and (8) expository instantiation.

The first three publications, following our publication framework can provide a substantial basis to build these components of a design theory. *Purpose and scope* (component 1) can be built on the design objectives stated in each of the publications. Components 2 and 3 can be built on the design principles and their conceptual and value grounding. *Justificatory knowledge* (component 6) exists in the form of explanatory grounding. As the publications from this dissertation report on the evaluation of prototypic systems, actually built *expository instantiations* are also available (component 8). However, not all instantiations feature all design principles, and it might therefore be necessary to instantiate the design theory in a subsequent step.

In the future work section, we suggest how the missing components can be derived to build a design theory in the next steps.

1.5 Conclusion

In the publications that constitute this dissertation, we have shown how computer-supported advisory services can be equipped with consumer education episodes. We have demonstrated examples of how systems, processes, and environments can be designed to enable effective consumer education during financial advisory services. Thereby we have specifically addressed the two research questions: (1) *How can IT artifacts be designed to foster knowledge transfer in financial service encounters?* – by providing exemplar designs that led to a significant improvement in the amount of client knowledge. And we have addressed (2) *"How can the advisory service (as a mixture of tools, processes, and environment) be designed to make the use of IT tools successful while retaining the traditional and anticipated social setting?"* – by designing the "education interleaved decision making" process and evaluating this process embedded in a realistic advisory service scenario. The question of how to retain the fragile social setting has been answered by an in-depth analysis of a failed prototype evaluation. Within a subsequent build/evaluate cycle we could demonstrate that these problems have been properly addressed (Heinrich, Kilic, Aschoff, *et al.*, 2014). We contribute all design rationale in the representation of design guidelines/principles to abstract from the specific implementation, thereby providing transferable design knowledge to support future design interventions for similar problems in other complex domains. With this research, we answer the call for action to support client education directly in the service encounter (Bradbury *et al.*, 2014). Client education during the service encounter is also preferable from an efficiency perspective. While other forms of financial education must transfer knowledge in advance and without an indication of whether or not it is eventually needed, just-in-time knowledge transfer only delivers the minimum of knowledge required and does not suffer from long-term knowledge decreases through forgetting (Fernandes *et al.*, 2014). However, the current predominant advice-giving process in these encounter types, which mainly follows the advice-giving and advice-taking model (Jungermann, 1999; Oehler & Kohlert, 2009), is not suitable because it strictly defines the client's role to an information provider, while the advisor makes all the decisions. With our *education interleaved decision-making process* (Heinrich & Schwabe, 2015), we offer a new process model that considers clients more as informed decision-makers (Gafni *et al.*, 1998). As our laboratory evaluations have shown, involving clients in the decision-making process by offering access to decision relevant topics was generally appreciated (Heinrich & Schwabe, 2015). While we would not argue that we had reached a state of true informed decision-making, this was a step in this direction. The advisor must still guide the client through the decision-making process.

During this research project, it also became apparent that the social settings in such service encounters are very fragile, and that the acceptance of naively designed IT artifacts can suffer severely if social interactions are disturbed (Heinrich, Kilic, Aschoff, *et al.*, 2014). The introduction of technology will influence the encounter's social setting, since it brings the 'spirit' of a third player (the institution) into the service encounter (Kilic *et al.*, 2015). This is a two-sided coin, as it can provide better standardization levels while it (sometimes without intention) forces behavior patterns that clients and advisors attribute to the use of the IT artifact (Kilic *et al.*, 2015). This must be carefully weighted in future designs. Furthermore, the use of an IT artifact will always change client-advisor interactions, as some time must be spent focusing on the artifact. This time, in which clients and advisors focus on technology rather than on each other, must be minimized in order to enable relationship building comparable to traditional service encounter settings (Heinrich, Kilic, Aschoff, *et al.*, 2014). This also is a tradeoff situation, as one would want to support all activities of the encounter while at the same time restricting the sole use of technology to an absolute minimum. This must be taken seriously, as these shortcomings in and disturbances of the social interaction can have severe effects on perceptions of IT artifacts as a whole and can diminish acceptance or preferences.

1.6 Limitations

This work has several limitations that affect the generalizability of its results. All research was done in close collaboration with Swiss financial institutions. While this strengthens the external validity of the results, it also carries the risk of including local cultural influences. Also, while we profit from resources such as real and experienced financial advisors for our laboratory evaluations, we were not allowed to conduct these evaluations with real clients from the bank and had to fall back on convenience sampling of test subjects (Heinrich, Kilic, Aschoff, *et al.*, 2014) or on students in the role of clients. While one might argue that students are not typical investment clients, they have a more homogenous financial knowledge compared to samples of typical clients, making them ideal candidates for evaluating design interventions related to knowledge transfer. Also, a laboratory setting usually does not involve real money, and therefore no decisions can be made that would impose any consequence on the person's future life. It therefore remains unknown how people would behave in these IT-supported encounters if their own money were at stake. However, for the conventional settings conducted in our lab, we could observe a large amount of behaviors reported in the literature taken from real-world encounters, such as *interaction-as-if behavior* (Jungermann & Belting, 2004), or shallow and unsuitable explanations (Oehler & Kohlert, 2009), even without the presence of monetary incentives to sell products.

Other limitations arise from the methodology of design research itself. While the design rationales are expressed by more abstract design principles, the instantiation's validity cannot be guaranteed (Lukyanenko *et al.*, 2014). While we sought to precisely describe the intentional design choices we made, there is always the possibility of unintentionally made design decisions influencing results (Heinrich & Schwabe, 2014). Also, the effects of individual design principles remain unknown, as they were evaluated simultaneously in bundles in one build-evaluate cycle.

1.7 Future Work

This dissertation contributes design knowledge to take a substantial step in the direction of informed decision-making enabled by consumer education. However, the research in this area is far from complete. Our laboratory results are promising but still tentative, as their transferability into the real world has yet to be shown. Subsequent research might transport these findings into the field and might apply them to real-world service encounter, and a pilot study would be necessary for a proof-of-use (Nunamaker & Briggs, 2012). Furthermore, this dissertation project explores several related phenomena in depth and addresses problems resulting from these phenomena with design interventions. However, the discussion of phenomena and problems does not claim to be exhaustive. There might be other, still unknown factors that influence a successful rollout and adoption into work practice. As mentioned, this knowledge must be gained during a proof-of-use evaluation. Findings from such an evaluation should also enable the formulation of a design theory on knowledge-enhancing financial service encounters. Better prototypes (or pilot systems) must be built and evaluated in order to address the needs of a real-world encounter, spanning a broader range of client segments and product offerings.

While, on the one hand, we plan to implement such pilot systems in the near future, we also work on a deeper evaluation of the value of several design principles used to construct our financial microworlds. In particular, we aim to answer the question to what degree *reflection-in-action* plays a role in knowledge acquisition success. This would be a key insight, because it would guide the design of the advisory process, especially whether or not it is valuable to advocate that clients should interact with a system by themselves.

The development of new advisory processes seems to be valuable in general. With our prototypes, we have partially replaced the current work practice of advice-giving and advice-taking in monolithic blocks of needs elicitation and solution recommendation (Jungermann, 1999) with iterative processes constantly cycling between these two blocks, to allow a constant assessment and adaptation of the solution by both client and advisor. We would argue that a process that enables one to involve the client in short cycles will ultimately lead to a better suitability of the final investment decision, compared to a monolithic model where only decisions on a low number of offers (Jungermann, 1999) are offered. We would assume similar effects of an iterative decision-making process in these service encounters, designing solutions to a client's current situation than in the other decision intensive domains such as software engineering, where agile process models such as SCRUM (Schwaber, 1997) are considered to be superior to monolithic models such as the Waterfall model (Schwaber, 1997). In subsequent research, we plan to deepen our understanding on that topic and to adopt knowledge from domains such as software engineering, where these principles of expert-layperson collaboration (client as layperson, software engineer as expert) are better understood and are addressed by means of effective processes.

PART II – PUBLICATIONS THAT CONSTITUTE THIS THESIS

2.1 Microworlds as the locus of consumer education in financial advisory services

(CONFERENCE PAPER)

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Abstract: The complexity of financial matters and the financial illiteracy of clients prevents informed financial decision making in current financial advisory services. We propose a novel approach to improve this situation: The advisor integrates small learning episodes directly into the service encounter. These learning episodes are implemented using the concept of explorative learning and "microworlds," i.e., small self-contained simulations. The resulting prototype is called "FinanceWorlds." An evaluation reveals that the system significantly improves client knowledge compared to traditional paper-based explanations. The paper contributes the generic principles underlying FinanceWorld's design to the knowledgebase on consumer education in financial (and other knowledge intensive) services. It thus supports practitioners in designing tomorrow's advisory encounters.

Keywords: Financial advisory services, Consumer education, Financial Literacy, Design Science Research

2.1.1 Introduction

In today's financial advisory encounters, clients are confronted with ever more complex financial products and constructs. Financial advisory services are constantly facing harsh criticism arising from public media coverage and industry studies (Schwabe & Mogicato, 2009), which has intensified during the recent financial crisis. A recent study (Oehler & Höfer, 2012) has quantified the loss due to bad financial advice to over 50 Billion Euros per year for Germany alone. Scholars (Oehler & Höfer, 2012) as well as the legislators (WpHG, 2011) demand the substantial enlightenment of clients regarding a financial product and its associated risks and chances. All these aspects boil down to the demand to educate the clients in order to enable them to understand the decision relevant aspects.

A work practice of rather uninformed decision making has established itself as the predominant mode of service delivery, to-date, in which clients select from a limited number of product offerings proposed by the financial advisor. Such a form of client-advisor-interaction has been described by Jungermann (1999) in his "Advice Giving and Taking (AG&T)"-model more than a decade ago. This is a dangerous practice because the advisor makes most of the relevant decisions by selecting and customizing products without proper client involvement. Kohlert and Oehler (2009) even go a step further, stating that financial service providers might not be able to fully enlighten the client on all relevant details of a financial product. All the information provided would inevitably lead to information overload (Oehler & Kohlert, 2009) and, as a result, reduce the quality of clients' decision-making capabilities. This paper focuses on consumer education during financial advisory services as well as its aforementioned difficulties to enable the client to understand the decisions at hand.

Amazingly, we see more than a decade of research on how people behave and decide in financial service encounters on the underlying problems of those settings. Although there are models to show why people behave in certain ways, a solution to improving financial decision making in service encounters is still missing. Insufficient *client knowledge* is the root cause of the problem because insufficient knowledge gives rise to principal-agent conflicts (Eisenhardt, 1989), hinders "informed decision making" (Jungermann, 1999) and leads to buying unsuited products (Inderst & Ottaviani, 2009). Many national and international studies (ANZ Bank, 2008; Brown & Graf, 2012; Chater *et al.*, 2010; Chen & Volpe, 1998; Volpe *et al.*, 2002) have documented a disastrous level of financial literacy for both the average population and active investors. Financially literate people, however, are in a better position to make good decisions (Chen & Volpe, 1998).

Despite the problems described before, financial products are sold daily. Financial service providers have indeed found a way of working around these obstacles. According to Jungermann and Belting (2004), insufficient decision capability is compensated by mutual trust, with both parties drifting into a role-play of "as-if" behavior: the client behaves "as-if" he has understood everything and the advisor behaves "as-if" she actually believes the client. As part of that "as-if play," very simplified presentations and drawings together with poor analogies are used whenever the client raises questions, or the "script" of the advisory process demands some form of explanation. If financial service providers are afraid of being legally sued, they can simply document the advisory session with the help of minutes (for example, mandatory in Germany since 2010), stating that the client has been fully informed about the associated product risks (Künzl, 2012). Some financial advisory service providers even take a simpler approach and let the clients sign a legal disclaimer when they are buying products.

This paper proposes an alternative solution: For the first time, to the best of our knowledge, we demonstrate how IT-based learning modules can be designed in order to be used during the encounter "just in time." Just in time consumer education has been suggested as a superior form of consumer education in the financial sector for reasons of knowledge decaying over time (Fernandes *et al.*, 2014). Further support is given by Chater et al. (2010): "An alternative policy approach might be to target very specific information - either related to financial literacy or decision-making literacy - at the point at which the consumer is making a decision."

The following hypothetical advisory scenario exemplifies the importance of a sufficient understanding of financial matters in order to make better informed decisions. The scenario is based on our own impression from prior field work. The explanations used in this scenario are based on information material provided by the bank:

Robert is 35 years old and works as a plumber. He lives a frugal live and thus has built up a significant amount of cash in his bank account. Robert has never invested his money in any financial product apart from his savings account. His advisor proposes an investment offer to him, triggered by the fact that his cash amount recently reached 200,000 USD. She suggests that Robert should visit his branch to talk with his bank representative. Robert is a risk-averse person, which the banker soon recognizes, and so she advises him to define an investment strategy of 90% bonds and 10% equities. The banker tells Robert that diversification in different asset classes is key to reducing the overall risk. Robert has a hard time understanding why having 10% risky equities will make his portfolio safer compared to a pure bond strategy. The banker uses analogies drawn from daily life: diversification is like a table with one leg broken but an extra one to support the weight. Robert remains puzzled and just trusts the banker. The banker tells Robert that the expected return with the proposed strategy is about 2% per annum, based on the data of the last 25 years, and that the volatility is expected to be 5%. To illustrate these figures, the banker shows Robert the expected portfolio development in the next 20 years, starting with a relative index of 100%. The graphic clearly illustrates the benefits of that strategy compared to a simple savings account. Based on these graphics and visual aids, Robert agrees, and they arrange an appointment in a week's time when the bank will offer Robert a concrete product and start implementing the advised strategy.

This short and rather stereotypic first time financial advisory scenario helps to highlight the problems that can arise when clients do not fully understand the aspects of the decisions to be made in today's financial advisory services. A client, in most cases not a financial expert himself, is often unable to understand the decision rationales because many complex financial concepts produce counter intuitive results. Even in the above-described simplistic case,

it remains unclear what the given information really means to Robert. What, for example, does he really understand by the 2% expected return? Can he really expect to get an annual rate of 2%?
Thus, our solution objective is to raise the clients' understanding regarding financial concepts/operations that are relevant to the decision-at-hand. We address this objective by designing an IT-system to support consumer education directly within the service encounter itself. We opt for a design based on the didactic method of experiential learning (Kolb, 1984). More specifically, we raise the following research question:

How can experiential learning environments be designed to foster efficient consumer education in financial advisory services?

Based on related work, we derive design principles that guide the construction of small and interactive learning modules (microworlds) to be used during the service encounter. We evaluate our designed system in a controlled setting where we compare the learning outcome when using our system with the learning outcome using pen and paper. In both cases, a financial expert from a large Swiss bank explains the topics to the participants using the two different methods described. We evaluated the system by assessing the participants' knowledge levels objectively as well as subjectively through questionnaires. We also questioned which method of explanation they would prefer. Based on the results, we suggest that such systems can foster the learning of financial concepts. However, there still seem to be cases where the system does not lead to an advantage. We will discuss these shortcomings as well as the overall implications later.

2.1.2 Related Work

This work relates to a stream of research that strives to overcome the asymmetric structures of traditional advisory services towards stronger client involvement. Novak (2009) has identified "information asymmetry" and the related principal-agent-conflict (Eisenhardt, 1989) to be one of three core problems of interactive involvement of clients in advisory service encounters. Information asymmetries occur on both sides: The advisor has limited information on the client's problem space and the client has limited information of the solution space (Novak, 2009). However, this article deals solely with one side of the information asymmetry, where the client has insufficient knowledge about the solution space. In relation to Novak (Novak, 2009) and Eisenhardt (1989), this asymmetry regarding the solution space is a precondition for raising of the principal agent conflict, where the client cannot verify that the advisor is behaving correctly. This is problematic, as the client does not know whether or not the advisor also has other (conflicting) incentives and might thus strive for his own goals, resulting in giving bad advice.

Access to information is a precondition but not sufficient to successful development of knowledge (Davenport & Prusak, 1998). This also has been researched in financial advisory service context: The mere provision of static context in the form of brochures, for example, has been demonstrated not to significantly change the knowledge levels of the clients (Chater *et al.*, 2010). Nevertheless, carefully designed IT artifacts can provide transparent access to information in financial service encounters and thus decrease the information asymmetries (P. Nussbaumer *et al.*, 2012). In order to transform information into knowledge, transparent access alone is not sufficient, as people have to engage in knowledge creating activities, such as questioning the given information with respect to its implications on decisions or actions (Davenport & Prusak, 1998).

Mayer (1989) assumes that learning outcomes (gain in knowledge), and thus also the learner's performance, are defined by the cognitive processes in the learner's mind. These processes are, according to his model, influenced by: a) the *learning material* (learning content), b) the *instructional method* (the method, how something is taught, including tools and presentations) and c) the *learner's personal characteristics*. Mayer uses the model with a "[…] focus on explanative material […]" (Mayer, 1989). This relates perfectly to the initially stated goal of explaining how financial constructs work with the help of explanatory materials, such as graphs, for visualization.

While Mayer's model is of a more generic nature, Kolb (1984) focuses on experiential learning. Taking a pure constructivist point of view, Kolb assumes that "knowledge results from a combination of grasping and transforming experience" (Kolb, 1984) and defines a four-step model called "*Experiential Learning Theory* (ELT)." The four steps/components of this model are: *Active Experimentation*, *Concrete Experience*, *Reflexive Observation* and *Abstract Conceptualization.* By iterating all of these steps during a learning cycle, an individual's knowledge level will be raised.
One conceptualization to support the experiential learning activities with IT systems is Land and Hannafin's (1996) *Open Ended Learning Environment* (OELE). They model how learners develop their understanding with an OELE (Figure 2). The similarity to the steps in Kolb's ELT is evident: The first three steps of the ELT model are covered by the experimental "Action"-"Intention" block, the "Feedback and Perception" block and the interpretive part. When closely examined, there are two experiential cycles embedded in Land and Hannafin's (1996) model. First, there is the outer and larger cycle, where the experiment as a whole is to be experienced by the learner, and then follows the smaller inner loop of adjusting action, according to intention. This mechanism is called "*reflection-in-action*" and dates back to Schön (Schön, 1983; Land & Hannafin, 1996).
This feature of learning through reflection-in-action offers a very efficient access to causal relationships. If a learner systematically explores OELEs, unanticipated behavior of the system can "trigger the learners' reflective process" (Land & Hannafin, 1996) and thus help to develop a better understanding. Reflection-in-action (hands on) also increases brain activation and learners' motivation (Klahr *et al.*, 2007).
Such interactive learning environments can be designed in various flavors, such as microworlds, simulations and games or as a mixture of them (Rieber, 1996). The (serious) games have been applied to a variety of educational settings (groups vs. individuals) and in many domains such as Biology, Medicine, Engineering and Math (Wouters *et al.*, 2013). A recent meta-study on the cognitive effects (Wouters *et al.*, 2013) covered 38 studies where a serious educational game was directly compared to its traditional counterpart.

That study showed that learning with serious games has a consistent and significant advantage, compared to traditional learning with a promising effect size (d=0.29). Furthermore, it was shown (Wouters *et al.*, 2013) that supplementing serious games with additional instruction methods, as well as working in groups, had a positive moderating effect on learning outcomes.
With respect to decision making, IT-supported learning has already been used to assist in complex problem-solving situations (Yuan *et al.*, 2013). In the context of finance, IT has been successfully applied in the form of simulated experiences to explain random distributions (Bradbury *et al.*, 2014). Bradbury et al. have proved in their specific case that the educational method of simulated experiences have a positive influence on investment decision-making, compared to mere information provisioning. Thus, it has been demonstrated that explorative learning environments can have beneficial effects in financial service settings. However, these solutions are only designed for usage in single user learning sessions and not for use in collaborative face-to-face sessions. Also, generalizable design knowledge on how to construct such learning environments is missing. Hence, more research is necessary to find out "what designs work for whom under what conditions" (Frezzo *et al.*, 2014). With this article, we contribute to this stream of research by presenting design rationales for a specific context and setting. We also contribute to the stream on financial service encounters, by presenting a practical approach to address insufficient client knowledge and its aforementioned associated problems.

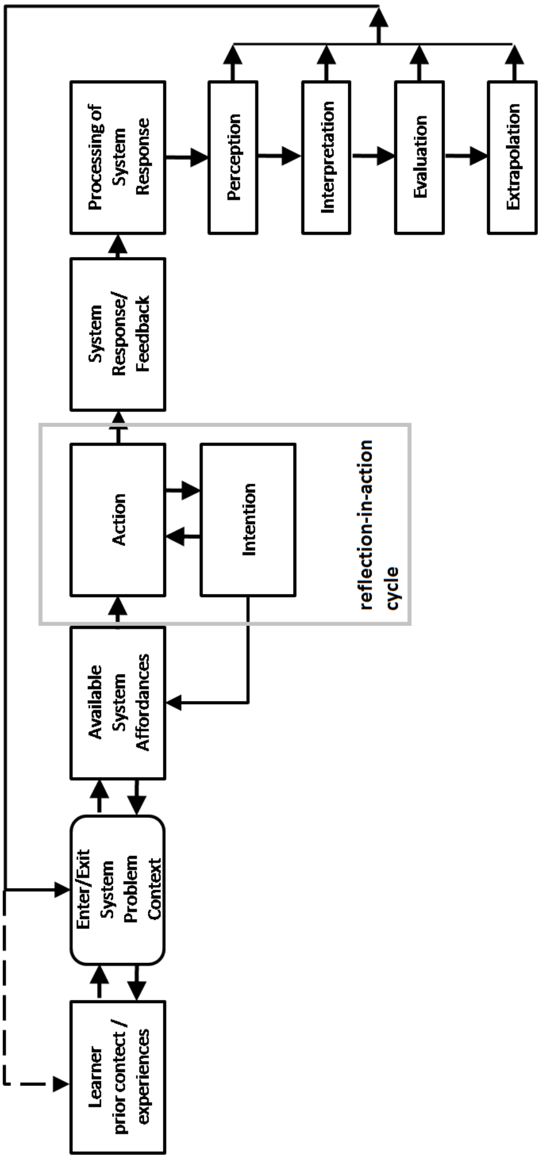

Figure 2: Model of theory development through OELE (Land and Hannafin 1996) with reflection-in-action cycle highlighted

2.1.3 Research Methodology

This research project followed the generic steps of Peffers et al. (2007) to conduct design science research in the IS field (Hevner *et al.*, 2004). This paper reports on the three cycles of design science research *relevance cycle, design cycle and rigor cycle* (Hevner, 2007). In the *relevance cycle* we derived the problems, provided basic solution objectives and gave arguments of why solving the problems is relevant to the described field for both practitioners and scholars. Through the *rigor cycle,* we grounded our design rationales within the identified set of kernel theories, domain concepts and empirical evidence. Hence, we followed a multi-grounded approach (Goldkuhl & Lind, 2010) by applying these grounding strategies to our main conceptualization of design knowledge by using the widely accepted method (Gregor & Hevner, 2013) of generic design principles (Van den Akker, 1999).

The design ideas emerged before evaluation and governed the creation of the artifact. However, abstract design principles were formulated after the evaluation. This is anticipated, as the different viewpoints of ex ante and ex post evaluation (Pries-Heje *et al.*, 2008) facilitate both induction and abstraction steps to extract design knowledge from DSR activities (Gregor *et al.*, 2013). The design cycle activities instantiate the design principles in a prototype. The evaluation step demonstrates the usefulness of the artifact with respect to the stated objectives, thus providing empirical evidence for the design principles (Goldkuhl & Lind, 2010).

Concretely, the design knowledge was crafted as follows: During the implementation of the prototype the researchers implemented 1) the knowledge in the system, relying on literature (see above), 2) background knowledge from previous design iterations (focusing on other issues of financial advice giving, not covering consumer education specifically) and 3) creative intuition. A first set of design principles was explicated directly after the end of the evaluation in January 2013. During the course of the next 15 months, we carved out the essential design knowledge in three subsequent versions of design principles (and in the first two versions: generic requirements). Each version was extensively discussed by the authors (in a group). We struggled to identify a minimal set of essential solution characteristics in the light of the problem and the kernel theories. A major issue we faced was identifying the appropriate level of abstraction in order that the design knowledge would be sufficiently general so it could be used in a wide area of applications, but still be sufficiently specific to be useful for a designer of a concrete solution.

Although the design knowledge was mostly explicated after the evaluation, we chose to present it before showing the evaluation results because the evaluation results can only be understood in the light of the design ideas. Refinements to our design ideas, emerging from observations made through the evaluation, are presented in the discussion section of the paper. Just presenting the prototype would be a poor proxy for presenting the design ideas.

The prototype was evaluated using experimental techniques. We derived the following working hypothesis from the solution objective: *Properly designed microworlds used within the advisory service encounter can outperform (from a knowledge acquisition perspective) traditional ways of providing paper–based explanations.* As the evaluation design is tightly connected to the data collection and the evaluation results, we will present it later.

2.1.4 Design Principles

The aim of this work is consumer education, more specifically, fostering the client's understanding of financial concepts/operations that are relevant to the decision-at-hand. This understanding can be furthered by applying the concept of OELE to the financial sector in the form of interactive microworlds. Microworlds are defined as "a small but complete subset of reality in which one can go to learn about a specific domain through personal discovery and exploration" (Rieber, 1992). Through the interactive nature (users can alter the casual variables, giving input to the model) and the provision of fast feedback (simulation and output visualization of the effects), these systems can support the whole cycle of experiential knowledge acquisition. We assume that if learners are enabled to modify the financial model's independent variables (*causes*), they will quickly grasp: a) whether their influence (*effect*) is positive or negative and b) the size of the effect present. In contrast to providing static content (such as in a brochure or a wiki for example), knowledge is internally constructed through experiences with the help of simulations (possible conceptualization displayed in Figure 3). However, there is little time to accommodate the client to the system. Hence the learning environment has to be as intuitively understandable as possible in order to be used in practical settings.

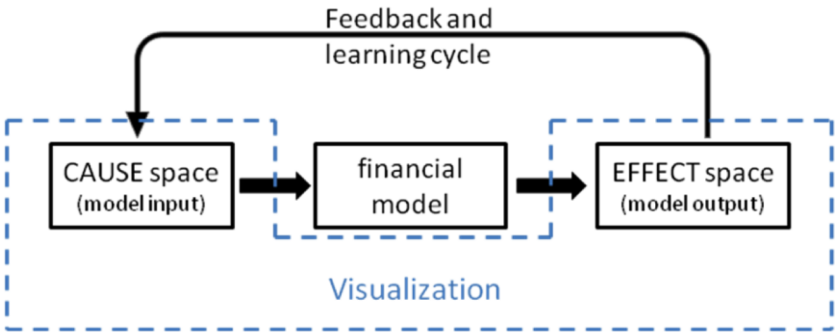

Figure 3: Cause space and effect space of financial model visualization

We argue that cause-effect relationships are most helpful when it comes to decision-making, as it helps to anticipate the outcomes of the decisions to be made. Furthermore, we argue that this kind of knowledge is hard to express in static forms of presentation (such as brochures or handwritten sketches). However, we are also aware that not all knowledge required by clients in order to fully understand their decisions can be solely expressed through cause-effect relationships. Therefore, we perceive our design solution to be a valuable extension of commonly used practices, rather than an all-embracing replacement.

We thus formulate our first design principle (DP):

DP1 "Enable experiences": *Represent all learning elements as simulated cause-effect relationships where the learner can alter the input (cause) and observe changes in the output (effect) in order to enable experiential learning.*

While learning can also happen (and probably will) outside the service encounter, this publication solely focuses on customer education during the encounter itself. However, service encounters are often very time-constrained. In the case of financial advisory services, the time the advisor spends with the client is often as low as 60 minutes (Oehler & Kohlert, 2009). Therefore, if customer education is to happen within the encounter itself, it has to be fast and efficient in order to be of practical relevance. Therefore, we focus on enabling reflection-in-action cycles. Often financial models have continuous cause variables (for example, the ratio of a risky asset class in the portfolio) and continuous effects (such as expected risk or expected return). Reflection-in-action offers continuous and fast exploration of the relationship while changing causal inputs. Therefore, for all causal relationships within the model, the system should support *reflection-in-action*.

DP2 "Enable reflection-in-action": *Offer reflection-in-action for all learning episodes.*

Repetitive exploration of specific cause values and their effects are obviously tedious, requiring high mental effort to reveal the underlying relationship. Memorizing the value of a cause before the effect that can later be observed requires additional mental effort. Therefore, the change of causal data needs to be immediately followed by the resulting changes to the effect data in order that no additional memorizing is necessary. Thus, we formulate the first sub-principle of reflection-in-action:

DP2.1 "Immediate feedback": *Give prompt feedback (i.e., change effect visualization) to any changes of the cause variables in order to enable fast reflection-in-action cycles.*

Generally, humans are not good at visually grasping two different aspects changing simultaneously (here, causes and effects) - a limitation that can be deduced from the multi-tasking research (Anderson, 2007). Anderson proposes that each sense is aligned with a separate mental resource. Although one can perform several tasks in parallel, one mental resource can only be used by a single task at a time (Anderson, 2007). Hence, when two tasks have to be processed by one mental resource at the same time, one task will have to wait. This implies that true multitasking only works by applying different mental resources for different tasks. Thus, continuous input control with one resource (normally the tactile resource, e.g., controlling the hand driving the mouse or the finger sliding over a touch screen) as well as monitoring the effects using another resource (normally visual) is the best way to allow humans to directly observe and understand cause-effect relationships. A linear mapping of the tactile motion to the causal variable corresponds with the natural expectation of the users and thus helps to "blindly" control a causal input variable. Land (2000) states “visual cuing” to "emphasize critical variables" as one key implication on the design of OELEs, to switch the learner's attention from the causal manipulation towards the effect visualization. This leads to the second sub-principle of reflection-in-action:

DP2.2 “Allocate different mental resources”: *Use controls and visualizations that require different mental resources for inputs and outputs of the system in order to enable reflection-in-action cycles.*

We propose to spatially separate cause and effect space in order to provide visual guidance. The cause space contains all relevant tactile inputs to the simulation, whereas the effect space contains all relevant visualizations of the model output. When spatially separated, the learner can focus on the effect space with his visual resource while manipulating the inputs with his tactile resources. Therefore, we formulate the following design principle:

DP3 “Group cause and effect”: *Spatially group causal inputs and effect visualizations to the identical regions of all learning elements in order to enable intuitive interaction.*

Mapped to the advisory scenario, the system should be capable of running financial models with a subset of independent (cause) variables. When the client advances, more and more controls of variables can be added, if appropriate. This also provides the learner with control over the learning process. This is important because financial advisory services are flexible processes. Neither clients nor advisors accept systems that explicitly enforce process steps to be performed (P. Nussbaumer *et al.*, 2012); rather, clients and advisors desire a free choice of functionality at any time at their discretion (P. Nussbaumer *et al.*, 2012). However, the number of controls and effect-visualizations has to be limited to avoid overloading the visual resource. The literature suggests the well-known maximum number of about seven (Miller, 1956). Therefore, we formulate the following design principle:

DP4 "Limit the input": *Limit the number of causal variations in order to guide the learner towards the desired observation.*

In contrast to the previous three design principles, DP4 has to be handled with care, because there could be a potential tradeoff between accuracy of the model and its understandability. Reducing a complex model too far endangers its value of information; reducing it too little endangers its general understandability.

2.1.5 Design solution

We instantiated our design principles in the form of an IT-supported learning environment. Accordingly, we implemented two microworlds providing a simulation-based access to financial constructs (Figure 4 and Figure 5). These served as an extension to an existing prototypic IT-artifact system supporting financial advisory services.

While the existing prototypic system solely focuses on the advisory process itself with the design goal of making the service more transparent (P. Nussbaumer *et al.*, 2012), our extension solely focuses on the learning aspect of financial models. We introduced two independent learning units LU1 and LU2. Both units use similar visualizations from the existing prototype to ease client's accommodation. Before explaining how the design principles are implemented in detail, the aim of this short activity scenario is to demonstrate the usage of our IT-artifact, as an example for one learning unit*:*

[…] Robert is a risk-averse person, as the banker soon recognizes, so she advises him to follow an investment strategy of 90% bonds and 10% equities. The banker tells Robert that diversification in different asset classes is key to reducing the overall risk. As the concept of diversification is new to Robert, the advisor immediately switches into the "learning mode." She presents Robert with an experimental environment where Robert can try different combinations of equities and bonds and where he is able to observe the effects of his manipulations to both risk and expected return. Soon, Robert discovers in the course of his interaction with the learning system that an optimal split between equities and bonds exists where the risk is minimized. The advisor also shows him that the effect is related to the independent performances of the two asset-classes (their correlation). Robert and the advisor experiment with different levels of correlation and Robert understands that the optimal ration between equities and bonds is independent of the correlation. As the advisor further explains that the market determines the independent performances of the asset classes, Robert is now convinced that the proposed split fits his needs of minimal risk best in any case. The advisor leaves the learning mode and continues with the normal course of the advisory process. […]

FinanceWorlds was deployed on a large 40 inch multi-touch table (Microsoft SUR40). The basic idea behind using a multi-touch table was to create a shared workspace for both client and advisor, thereby reducing the obstacles of explicit control handover (P. Nussbaumer *et al.*, 2012).
The first learning unit LU1 covers the Portfolio Theory (Markowitz, 1952), simplified to a portfolio containing only three asset-classes with different risk profiles (equities, bonds and risk-free savings). This allows for examining the effect of diversification (Figure 4) (Weber, 2007).

The learners can experiment with three independent variables of that model: 1.) Percentage of risk free assets as part of the total portfolio, 2.) Ratio of equity and bonds in the remaining part of the portfolio and 3.) Correlation between the prize of assets and the prize of bonds (to include crisis situations in the model). The effect on the risk-return curve is visualized on the right part of the screen in Figure 4. Such risk-return-diagrams are common in financial advisory services and thus known to the client either from previous experiences or from the ongoing advisory session.

The second learning unit, LU2, features the simulation of future wealth development (Monte-Carlo-Simulation) (Figure 5). This unit allows the learner to experiment with various portfolio properties (Figure 5 on the left) to learn about their impact on the future development of wealth (Figure 5 on the right). Three causal adjustments can be made in the corresponding space: The expected volatility, the expected return and the simulation duration (in years) can be changed independently by using three sliders. The effect space is visualized using a coordinate system, depicting the total wealth in relation to simulation time. The blue area in that coordinate system is the 90% percentile where the value of the portfolio is expected to reside.

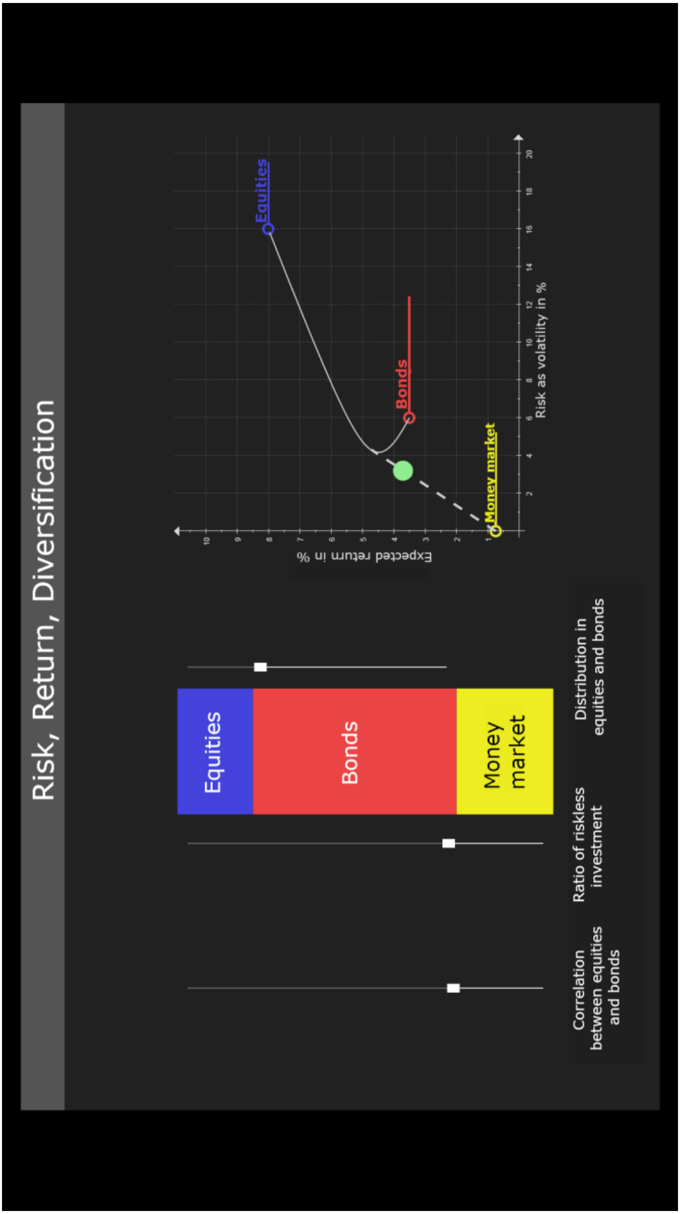

Figure 4: Learning environment for Portfolio Theory, Learning Unit 1 (LU1) (original screens in German language)

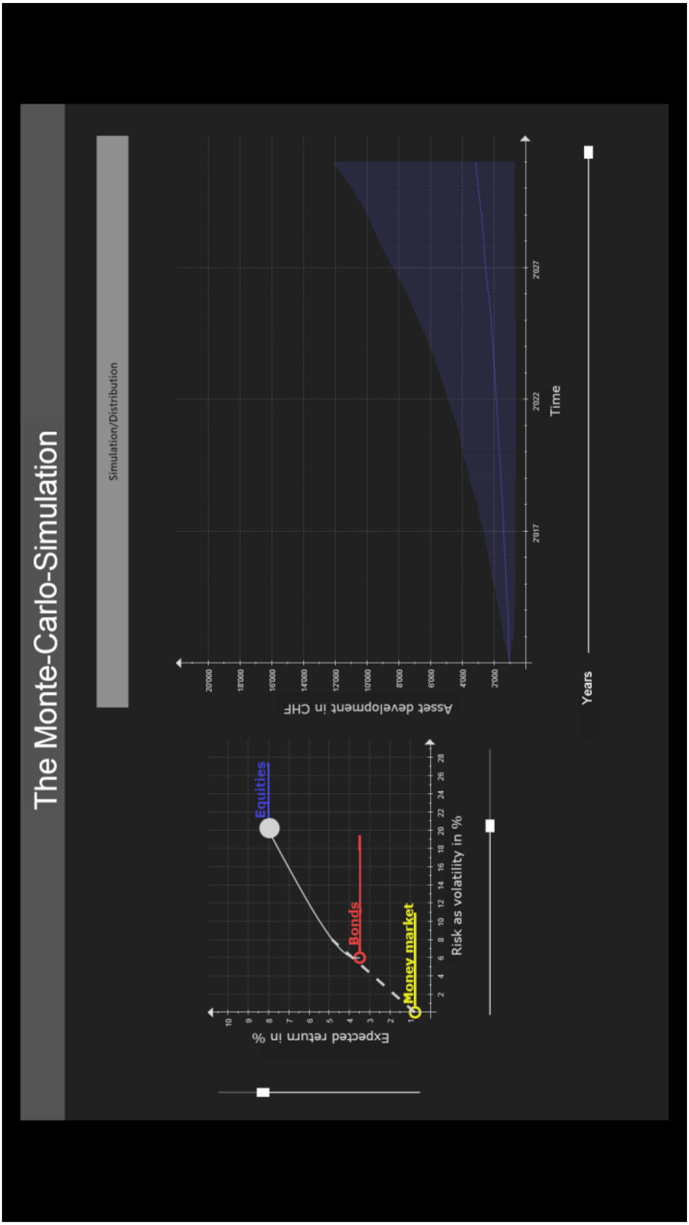

Figure 5: Learning environment for Monte-Carlo-Simulations, Learning Unit 2 (LU2) (original screens in German language)

For both LUs, the prototype implements the design principles in the following manner: Both learning units are designed as interactive simulations (DP1). The consumer can thus interact with the learning environment at any time. The causal controls are grouped in a cause-space on the left hand side and effect-space on the right hand side (DP3). For the manipulation of the causes, we used a restricted number of three sliders (DP4). People are used to operating sliders both in virtual and real worlds, and a precise input is not required for grasping the effects. The consumer can use one slider as analog input control metaphor with one hand and simultaneously observe the effect with his eyes (DP2.2). The prototype reacts instantly to slider movement with effect output (DP2.1). Therefore, repetitive explorations of cause values and their effects are supported (DP2). Every learning unit features only a single topic and the topic is covered entirely within a single screen.

2.1.6 Evaluation

In design science research, an evaluation measures achievement of the solution objectives (Peffers *et al.*, 2007). In our case, the design goal was to improve customer education (learner performance) during the advisory service encounter. The improvement can be measured by comparing traditional paper based knowledge transfer with our microworlds-based method of knowledge transfer. We applied experimental techniques to implement this comparison. Before we go into the details of the experimental set-up, we will briefly introduce the evaluation model.
The evaluation is based on a simplified and adapted version of Mayer's (1989) model; the learner's performance serves as the dependent variable and the instructional method as the sole independent variable. We assume that the instructional method influences the learner's performance through changes in the cognitive processing (Figure 6).

Figure 6: Evaluation-model (simplified version of teaching/learning performance-model (Mayer, 1989))

By varying the instructional method from paper-based descriptions to microworlds-based exploration, we enable fast reflection-in-action cycles, increase the learner activation and motivation, as well as decrease cognitive switching, as explained in section *Related work* and *Design Principles*. We propose that these increases/decreases lead to more, or more effective, cognitive processing by the client, and thus will improve learner performance. As typical in exploratory design science research, we only evaluate bundles of independent factors tied together by one artifact instantiation. We therefore do not propose hypotheses on the individual factors, such as the effect of isolated design principles. We rather propose that the described changes in all instructional method characteristics lead to an increase in cognitive processing and a subsequent increase in learner performance.

Evaluation of the learning environment was embedded within a complete service encounter to retain a realistic setting. The financial advisory service encounter itself was supported by IT throughout the entire time and included the following typical steps: Smalltalk, understanding of client's financial situation, risk perception and future financial goals before seamlessly diverting to the learning treatments. Details on this IT-support-system without the learning modules, can be found in prior publications (P. Nussbaumer *et al.*, 2012) of our research group. During the encounter, each subject received two training episodes: a traditional pen and paper explanation on one learning task and an explanation with the prototypic system on another learning task. Thus, the clients were able to compare both treatments and we could test each learner's performance on both treatments. Both learning tasks on LU1 and LU2 were prepared for both instructional methods. We randomized the order of instructional methods.

We expected that the learning success would be strongly related to the financial advisor's performance. To avoid this bias, two measures were taken: First, all explanations were provided by the same financial expert from a major Swiss bank who had not been involved previously in the research. Second, to ensure that all participants received the same treatment with the same quality of explanations, the expert was recorded on video and this video was used to instruct each participant during the encounter.

The explanation of each learning unit (LU) was simultaneously recorded from two perspectives: First, we filmed the advisor from above in order to capture the writings and drawings he did on pen and paper or the manipulations when working with FinanceWorlds. Second, we filmed him upfront in order to capture his facial expression during the explanations. Figure 7 shows the final setting for the subjects, demonstrating both instructional methods. For each LU, we first recorded the financial advisor using pen and paper, before we introduced him to our system, as we did not want to influence his method of explanation. In the pen and paper recording, he started with a stack of empty A4 paper sheets and consecutively wrote on the papers during his explanations. For the IT-supported recordings, the camera positioning was the same, but the table was replaced by the multi-touch tabletop running the FinanceWorlds environment. Two experienced researchers provided the foregoing advisory sessions. To exclude a systematic influence of this advisory session, the combination of learning tasks and instructional method was only randomly selected after the foregoing financial advisory session was completed.

For the recording of the learning units, we could not control for the length of the financial advisor's explanations because we did not want to give him a detailed script telling him when to do what. Our aim was to let the expert explain as "natural" a manner as possible; he decided how to explain the contents of the learning units and how extensive his explanations would be. In fact, the duration for the first learning unit just differed by 23 seconds and the second learning unit differed by 115 seconds (see Table 3) concerning the instructional method.

Figure 7: Video stills of the two treatments (*top*: traditional desk with pen and paper; b*ottom*: IT-supported learning environment).

Table 3: Timing information for treatments

	Pen & Paper	**IT-Supported**
Learning unit 1	11:11 [s]	11:34 [s] (incl. 2x90s active experimentation)
Learning unit 2	10:31 [s]	12:26 [s] (incl. 2x90s active experimentation)

The paper and pen sessions exclusively consisted of explanations by the advisor. In the IT-supported treatment, the subjects were also encouraged to interact with the system themselves for 180 seconds (in two 90 seconds episodes).

The experimental subjects were third year bachelor students[1]. We had to assume that some of them had taken a university course with investment related topics. We therefore had to increase the difficulty of the learning tasks compared to the ‘normal’ financial service advisory audience. However, the topics covered are identical to those discussed in real life investment advisory service. Paper versions of the two visualizations, Risk-Return-Charts and the Monte-Carlo-Simulation, are used by a major Swiss bank in their advisory service encounters on a regular basis.

A questionnaire was applied to assess the learners' performance (see appendix). It consisted of statements the subjects could answer with ‘correct,’ ‘incorrect’ or ’I do not know.’ For the evaluation, we counted the number of correct answers only. The questionnaire was based on two sources. For LU1, we consulted an introductory book for people interested in financial investments (Weber, 2007), with a focus on the topic of portfolio theory. For LU2, we used a textbook on Portfolio management (Spremann, 2002).

In addition to the objective post treatment knowledge, we also assessed the influence on the perceived knowledge. We used Flynn and Goldsmith's instrument (Flynn & Goldsmith, 1999) for this purpose. Consisting of five items measured on a Five-Point Likert scale (strongly agree – strongly disagree), the questionnaire asked the participants to rate their perceived knowledge level with reference to that of their peers and other people in general.

In addition to the assessment of knowledge level, participants were asked which instructional method they preferred.

[1]plus one student who had graduated a few weeks before the experiment as a replacement for a short notice drop-out subject

For all measurements, we treated the video-explanation using traditional pen and paper method as the baseline reading. These pen and paper based explanations resemble today's work practices within our controlled environment.

2.1.7 Evaluation Results

The 38 participants were all students from a Bachelor Business Informatics course (with the exception of one doctoral student), four of which were female students. Of the original 38 participants, 37 were included in the analysis. One participant was removed because he refused to complete the questionnaire. The participants were approximately 24 years of age ($m=23.97$, $s=3.3$, min=20, max=40). Six had prior experience with investment advisory, but only two had actually received professional financial advice themselves. Thirteen of the participants stated that they had taken a university course where the topic of investments had been discussed previously.

Participants in our sample using the FinanceWorlds protoype gave 61% correct answers, compared to 46% correct answers of those instructed with the pen and paper method. The difference of 15% is highly significant (two-sided paired t-test, $T(36)=4.38$, $p<0.001$).

However, when splitting the results into the separate learning episodes, only the candidates that used the Microworld for LU1 did profit from the method (Figure 8): They gave over 76% correct answers, compared to 44% of the pen and paper treatment. Using either the microworlds or the conventional pen and paper based situation for LU2 did not make any difference (both treatments reached 48% of correctly given answers).

During the microworlds phases of the evaluation we could observe different interaction patterns in LU1 and LU2. In LU1, most of the participants accomplished the intended focus switch from cause- to effect-space. In LU2, the subjects mostly kept their focus on the cause space, trying to adjust their input to concrete values instead of exploring the effects of their manipulations regarding the financial model.

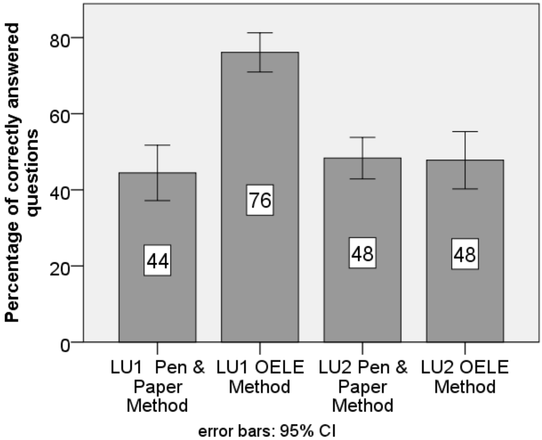

Figure 8: Overall objective knowledge results for both methods

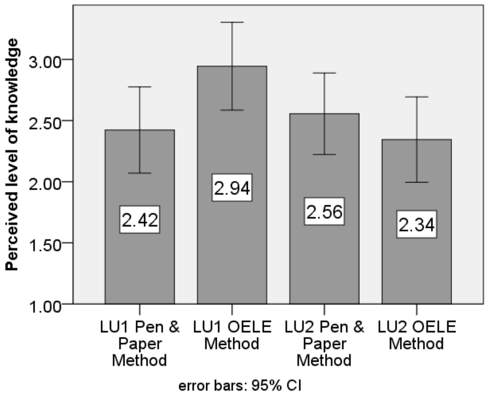

Figure 9: Subjective knowledge results for both methods and learning episodes (five-point Likert scale)

The results of the perceived subjective knowledge are displayed in Figure 9. Again, only participants using the microworld for LU1 could profit from the method. They rated their perceived knowledge 0.52 points higher using the microworld compared to the traditional setting on a five-point Likert scale. The result is significant (two-sided unpaired t-test, $T(35)=2.209$, $p<0.05$). For

LU2, the participants felt even slightly less knowledgeable when using the system but the difference was not significant.

Over all, the test participants preferred the FinanceWorlds based approach over the traditional pen and paper method. On a seven-point Likert scale, eight people preferred the traditional method, five people were indifferent and 24 people preferred the OELE. The preference for the new system was significant ($m=4.92$, $s=1.83$, one sample t-test, test value 4, $T(36)=3.05$, $p<0.005$). Participants who used the microworlds for LU1 rated the preference towards IT-supported learning much higher ($m=5.56$, $s=1.79$; one sample t-test, test value 4, $T(17)=3.69$, $p<0.005$) compared to participants who used the microworlds for LU2 ($m=4.32$, $s=1.70$, one sample t-test, test value 4, $T(18)=0.81$, $p=0.43$).

2.1.8 Discussion and Conclusion

The results of LU1 suggest that properly designed microworlds can foster learning in a financial advisory setting. The experimental subjects had more financial knowledge after an experiential learning episode (supported by our FinanceWorlds prototype) than after a traditional paper based explanation. We attribute these improved results not only to an increase of the client's applicable cognitive capacity, but also to the learner activation. We assume that the following microworld characteristics contribute to these changes: the applicable cognitive capacity is increased by making use of additional senses and by using the brain’s capability to link changes in causes and effects if they are presented simultaneously. The learner is activated by engaging in reflection-in-action cycles. Using the client's personal life situation as starting point, we aim to increase his motivation; however, more research on this aspect is needed. The integration of the learning environment into the advisory system arguably decreases cognitive switching costs, as the client has a solid pre-knowledge of the relevant financial models and the microworld’s user interface.

In order to reap the benefits, users have to open their minds to learning approaches other than traditional lecture style teaching. Experiential learning turns out to be a useful approach to engage clients and to transfer fundamental financial knowledge to them, even if only a limited amount of time is available.

Why can advisors not use the operational financial advisory system for experiential learning? Our study identifies a set of subtle but important design differences that can be traced back to the different goals. While a valid goal of an operational advisory system might be decision making and *information* transparency (P. Nussbaumer *et al.*, 2012), the goal of the microworld enriched system is knowledge acquisition. While the operational system can be (and in fact is) used most of the time by the advisor, experiential learning requires the microworlds to be operated by the client. As clients get advice only in very infrequent intervals, the embedded microworlds must be very intuitive and less complex than the operational system. The small and self-contained nature of microworlds allows the client to easily take over control in infrequent intervals. These microworlds run in a protected mode in several senses: The learning modules are visually isolated from the rest of the system. Furthermore, the system assures that no real data are changed while the clients interact with the learning environment.

On the other hand, the simulation-based approach provides a more dynamic interface by offering continuous data input (through sliders) instead of discrete but precise number input (i.e., through text boxes). However, the real client's data could also be used as a starting point for the exploration. Here, the similarity of the interface and the applied models assure small switching costs between advice giving and learning.

Without our prior intention, the results also show how carefully a system must be designed if it really wants to reap the potential benefits. For LU1, the system followed the guidelines, and we could subsequently observe a highly significant increase of learner performance. In LU2, that did not seem to happen, although it was designed following most of the same guidelines. We provide two tentative explanations for this. First, while using the same input metaphor, we did observe that the subjects stuck to the cause-space and thus did not have the intended experiences. We assume that by confronting the learners with simultaneous visualizations in the cause and effect space

(Figure 5), we overloaded their visual channel and thus observed typical multitasking problems. One other possible explanation is that the effects of the cause variables of LU2 were not independent of each other. Some cause variables had a moderating effect, that is, some of the effects could only be observed under certain conditions. Further research is needed on those observation.

However, we conclude that careful attention should be paid to the design of the learning environment. Guiding the visual attention of the learners is key to ensure that they can make the intended experiences and engage in reflection-in-action cycles while interacting with the microworlds. To achieve this, the arrangement of causal input and effect visualization has to be combined with appropriate input control to fully utilize the learner's resources through a variety of channels.

This paper offers typical design science contributions: design guidelines on a novel system type as well as in their prototypical instantiation. Requirements and guidelines primarily inform the design efforts of developers of financial advisory systems. We are confident that the results can also be applied to other settings involving advice giving using simulations (e.g., insurances, tax advice, etc.). Secondary benefits can be reaped by clients and advisors using the novel system or banks hosting the advice-sessions: With our solution, the client can gain knowledge specifically tailored for his personal life situation and thus he is better able to understand problems and offered solutions. Clients could not achieve this individually before the advisory session, as their relevant topics and knowledge gaps were unclear or unidentified at that time. Educating clients also helps to shift the decision process more towards the clients (Jungermann, 1999) and thus engaging them in a value co-creation process (Prahalad & Ramaswamy, 2004).

Fostering informed decision making (Gafni *et al.*, 1998) is assumed to result in a higher decision quality, an implication that financial service providers could also profit from in terms of customer satisfaction and retention. Using our system, financial advisors could also assess the client's knowledge and thus comply with the regulations (WpHG, 2011).

We furthermore synthesized design rationales in the form of generalized design principles. Therefore, it can be applied in many dyadic expert-layperson learning scenarios, such as doctor-patient interactions or value co-creation activities in travel counseling. Consequently, we see a potential for microworld based consumer education to significantly change the client-advisor relationship and the advisory experience in many domains.

Limitations

The applied research methodology not only has strengths but also some limitations: We see strengths in the controlled experimental set-up. The explanations, given by a top financial expert from a major Swiss bank, were consistently presented to the subjects using video recordings. Limitations largely result from the design science research background: We cannot attribute the successful application of the novel system to individual factors such as design principles, as we tested them in a bundle. Furthermore, we used students as client subjects. We had to adapt the learning task to their higher learning capability. The low number of test subjects limits the generalizability of the results. Further research needs to control for individual characteristics and extend the domain of IT-supported consumer education to deepen our understanding of the design rationales.

2.1.9 Appendix

Table 4: Yes-No questions to assess the knowledge level of the participants.

Learning Episode 1	Learning Episode 2
1. The price of shares is subject to gains and losses of the company.	11. It is assumed that the simple annual return is normally distributed, which means that it is equally likely to lie above or below the expected value.
2. The total interest profit on bonds is paid at the end.	12. For a skew-symmetric distribution, the mean and mode are approximately the same.
3. With sufficient liquidity of a company, there is still a risk of loss at the end of the term of bonds.	13. The expected value of the portfolio is the value that is most likely reached.
4. The interest income from bonds is usually above the market profit.	14. Mode, median and expected value are closer together, the higher the expected risk is.
5. Equities already generate profit during the investment period. (excluding dividends).	15. It is a priori more likely that the assets of an investor will develop below the median and mean of all simulations.
6. The price fluctuations of equities are usually smaller than those of bonds.	16. The value of the portfolio is at the end of the simulation (t> 1 year) normally distributed.
7. In normal market conditions, the correlation between equities and bonds is low.	17. An increasing expected return (at t>1 year) only shifts the distribution; the shape of the distribution remains constant.
8. A negative correlation between equities and bonds is categorically impossible.	18. The simulation can also be explained by "Brownian" movements, i.e., each simulation with the same parameters leads to a different result.
9. The effect of diversification is especially strong if the asset classes are positively correlated.	19. The median line in the Monte Carlo simulation shifts with increasing risk downside.
10. With decreasing correlation the expected risk also decreases; however, the expected return is the same.	20. The median line in the Monte-Carlo simulation is not linear with time.

2.2 Just-in-time Consumer Education in Financial Advisory Services

(JOURNAL PAPER)

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Teaser: Clients do not understand what they are doing, advisors act in their own interest, and 20 to 50 Billion EUR are lost. In this article, we address the problem of insufficient financial literacy in service encounters. We apply design research methodology to design a novel IT-artifact and a novel advice-giving process that incorporates consumer education during the service delivery. In a realistic laboratory evaluation, we demonstrate its effectiveness with respect to fostering clients' knowledge on decision-relevant financial topics. We contribute design guidelines and an artifact instantiation. We discuss how these results contribute to practitioners from the field financial services as well as to research on service science.

Abstract: Insufficient understanding hinders informed decision-making in financial service encounters. This problem is well known in practice as well as in the literature. However, previous attempts to raise clients' knowledge levels seem ineffective. In a small field study, we analyze financial advisors' current problems concerning consumer education. Driven by these problems, we design a new approach to educate clients during the service encounter, supported by an interactive IT-based tool. Our main design intervention is to align small, independent, and explorative educational activities with client decision-making activities in order to provide *on-demand* and *just-in-time* education. An evaluation of such a system has proven to successfully raise client knowledge on decision-relevant topics. Here, we formalize our design rational into generalizable design principles that are also adaptable to other financial services and related domains.

Keywords: Consumer Education, Financial Advisory Services, Microworlds

2.2.1 Introduction

Clients do not understand what they are doing (Oehler & Kohlert, 2009; Chater *et al.*, 2010), advisors act in their own interest (Novak, 2009; Oehler & Kohlert, 2009), and 20 to 50 Billion EUR are lost due to making inappropriate investment decisions (Oehler & Kohlert, 2009; Oehler & Höfer, 2012). Observations, closely associated with the customer's limited understanding of financial matters hinders informed decisions making. Legislators slowly start to react and put the banks under pressure to tackle this unsolved problem and hence ensure that clients understand their buying decisions and consequences (Bohlen & Kan, 2008; WpHG, 2011). This is a very ambitious goal that would require three mayor aspects to be successful: "Consumers need to (1) know what pieces of information they need; (2) process those pieces with factors relating to their situation, tastes, and preferences; and (3) use the output to make decisions about what financial products to purchase." (Kozup & Hogarth, 2008)

However, the mere enforcement of consumer education by legislators without the presence of effective methods can be counterproductive. First, the banks started to deal with financially illiterate clients on a contractual level where clients sign documents and simply confirm to the bank that they are knowledgeable. Then, the legislators reacted by requiring financial institutions to provide more extensive documentation; this is insufficient because swamping clients with documentation does not necessarily lead to a better understanding of products or better decisions (Chater *et al.*, 2010). Thus, financial advisory services face key challenges in the establishment of effective consumer education to enhance client decision-making abilities. Besides compliance issues, consumer education has proven to also enhance a client's loyalty and ability to value service quality (Bell & Eisingerich, 2007).

While clients did not seem to become more knowledgeable in the past decades, as numerous studies around the world have shown (Chen & Volpe, 1998; ANZ Bank, 2008; Kozup & Hogarth, 2008; Chater *et al.*, 2010; Brown & Graf, 2012), preconditions have significantly changed in the past decade. Clients now have access to a huge variety of information resources through public media and the internet from both dependent and independent information sources (Nussbaumer *et al.*, 2011). Furthermore, financial education programs have been implemented in "financial institutions, community groups, schools, and employers" (Kozup & Hogarth, 2008). Yet, apparently, none of those changes have positively impacted people's financial literacy – stagnating levels of low financial knowledge have been measured across the world (Chen & Volpe, 1998; ANZ Bank, 2008; Kozup & Hogarth, 2008; Chater *et al.*, 2010; Brown & Graf, 2012).

We explore the options of educating consumers on the basis of on-demand and just-in-time directly in the service encounter.

Hence our research question is: *How can a service encounter (process and tools) be designed to raise a client's knowledge level through consumer education?*

We have chosen to research this topic in the domain of retail banking, because the largest number of clients is affected here, and the financial literacy levels are lowest.

The paper is structured as follows: First, we review the related literature to show what has already been done to address the lack of client expertise and to identify possible solution approaches. After a short description of the research methodology, we report on a small explorative field study and identify problems in the current work practice and constraints on the feasibility of possible solutions. Based on these problems and the literature reviewed, we derive design principles to govern the design and development of a prototypic system. This instantiation of our design rationales is then evaluated in a laboratory setting against the primary solution objective of raising client knowledge levels in a realistic evaluation scenario with real financial advisors. Conclusions and implications are drawn based on the findings during the evaluation. We interpret our results in the discussion section and note the implications of this work for practice and research.

2.2.2 Related Work

The question how a client should be integrated into the decision process has long been discussed. The discussion distinguishes between two service encounter models: *informed decision-maker* and *perfect agent* (Gafni *et al.*, 1998). In the first model, the client makes all decisions, while in the second model this responsibility is completely transferred to the advisor who acts as an agent. Despite its theoretical appeal, neither model is purely viable in practice, because *informed decision-making* requires the transfer of profound domain knowledge from the advisor to the client, while the *perfect agent* model requires a client to transfer their *utility function* (Gafni *et al.*, 1998) entirely to the advisor. Therefore, any practical service falls in between these two extremes. The literature assumes that encounters are perfect agent encounters (Oehler & Kohlert, 2009). Such encounters have been conceptualized in a more general model of *advice-giving-and-taking* (Jungermann, 1999), which is still subject of investigation in more recent literature (Oehler & Kohlert, 2009), where its applicability in today's financial retail services was again verified. The original model (Jungermann, 1999) contains four phases: (1) the description of the problem, (2) the identification of an option by the consultant, (3) the offer of an identified solution, and (4) the client's decision to accept or reject the offer. This model is not restricted to financial advisory services, but targets any complex and decision-oriented advisory services (including medical advice-giving). Oehler et al. (2009) have critically analyzed current financial advisory services in retail banks and discussed their findings following the three phases of financial advisory processes (information collection phase, information phase, and recommendation phase). Concerning consumer education, they identify significant barriers in each of these phases that hinder *informed decision-making*. During the information collection phase (phase 1), they criticize the practice of asking 'general questions' (e.g. asking if the client has previous experience of buying stocks) in order to assess a client's knowledge and expertise levels. This method is very sensitive to the specific formulation of questions and produces highly *subjective self-assessments* (Oehler & Kohlert, 2009). For the information phase (phase 2), Oehler et al. conclude that *information overload* is inevitable, given the vast amount of information necessary to provide the required basis for a truly informed decision. For the recommendation phase (phase 3), Oehler et al. identify two problems if a client lacks profound knowledge: First, clients are not aware of all solution options to their problem, because the advisors only preset one (or a small number of options at best) as a final solution for acceptance or rejection. Therefore, according to Oehler et al., an objective assessment of the solution is no longer possible, so clients might fall back to *person-related attributes* (e.g. trustworthiness) of the service staff as their only source of judgment. Oehler et al. also point out the harsh time constraints in retail advisory services: In their field study, they found the service times to be on average 49 to 68 minutes, depending on the scenario.

Both Jungermann (1999) and Oehler et al. (2009) paint a pessimistic picture of the problems associated with informed decision-making, and argue that they basically cannot be solved at all, owing to the inherent and significant burdens induced by the complexity and quantity of the required knowledge.

Given these challenges and limitations during encounters, it is unsurprising that consumer education attempts prior to a service have even greater potential for failure. Despite the ubiquitous availability of potentially valuable information, selecting the information relevant to an upcoming advisory service appointment is a demanding task. Nussbaumer et al. (2011) found that the average investor uses professional financial advice relatively late in the information process. Despite the problems of identifying, memorizing, and evaluating the quality of the information sources, most clients first turn to the internet (Nussbaumer *et al.*, 2011). This could potentially lead to all sorts of problems, such as fragmented knowledge, inadequate or missing knowledge, and wrong assumptions, etc.

A recent EU study (Chater *et al.*, 2010) addressed the question of when and how to perform consumer education in the financial sector. Regarding the question when customer education should be performed, the study identified the service encounter as an ideal point to convey the relevant information. According to the study, the information in the service encounter can be tailored to the customer and be more specific (in contrast to a broad education on financial topics) and delivered right at the time of the decision. It was also experimentally demonstrated that the mere provision of additional information in a service setting has no significant effect on a client's decision capability (Chater *et al.*, 2010). This is in line with Burton's (2002) general model of consumer education, which assumes a relationship between the *knowledge distance* between provider and client and the knowledge transfer method used. In a low knowledge distance service (e.g. a haircut), the simple provision of relevant information might be sufficient, whereas in complex services, an educational setting is required to provide more than just information.

We consider the service encounter to be a promising place to transfer the relevant knowledge. Recently, the necessity to transfer knowledge when it is needed was also stressed (Fernandes *et al.*, 2014) in a study, which noted that knowledge (and its otherwise positive effect on decision-making) decays over time and that a just-in-time knowledge transfer is therefore preferable.

Besides this, most of the existing literature has a pessimistic view on effectively performing consumer education in the financial domain, and concrete solutions are still missing. However, in other domains such as the production of physical goods, the problems of overwhelming product variety and customer difficulties to deal with this have been addressed in research on mass customization (Huffman & Kahn, 1998; Piller, 2004; Salvador *et al.*, 2009). The general consensus in this research stream suggests that a systematic approach to guide customers through the decision process can resolve the problem of dealing with a large variety of products and options (Piller, 2004; Salvador *et al.*, 2009). Contrary to the conclusions drawn in the financial sector, technology has proven to help customers in their decision processes; for instance, automated sales configurators (Trentin *et al.*, 2013).

To our best knowledge, the closest approach to enhance client decision capabilities in the financial sector has been presented in the work of Bradbury et al. (2014), whose work incorporates the notion of *simulated experience*, where clients are provided with simulations of random distributions. In their article, the change in participant investment behavior was analyzed after a demonstration of a risk-return simulation with those getting just a description of the same topic. Bradbury et al. (2014) found that investors educated in a simulation are willing to invest in riskier products compared to those that received only descriptive information. The afore-mentioned investors also showed less regrets about their decisions afterwards. Bradbury et al. (2014) explicitly call for action to implement such actions in real-world service encounters.

Systems that seek to foster knowledge transfers have generally been discussed in other educational settings. Such systems can be conceptualized as experience-based learning, which has been discussed from a theoretical perspective (Kolb, 1984; Gentry, 1990; Kirschner *et al.*, 2006) and from a perspective of how IT-based tools can foster learning activities (Hannafin, 1994; Rieber, 1992). Such learning tools are often conceptualized as *open-ended learning environments*, where the learner can gain knowledge through active exploration within interactive simulations (Hannafin, 1994; Land & Hannafin, 1996; Land, 2000). If this is reduced to the exploration of single causal constructs, then these systems are also called *micro-worlds* (Rieber, 1992), because they focus on the exploration of a single concept in a reduced (micro-) environment. We have explored the concept of these micro-worlds to educate clients on financial matters with such micro-worlds (Heinrich, Kilic & Schwabe, 2014). However, the crucial step of embedding such micro-worlds in the service encounter is still missing; we explore this here.

2.2.3 Research Framework

With the goal to design a service encounter that fosters knowledge transfer, we followed the design science research methodology described by Peffers et al. (2007). We engaged in all its six proposed activities and communicate the results here: (1) Problem identification and motivation, (2) define the objectives for a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication. During all activities, we worked closely with a large Swiss retail bank.

To deepen our understanding of the problems found in the literature, we conducted a field study where we interviewed the relevant stakeholders and brought them together in focus groups. Based on the results of that field study, we formulate problems (1) and objectives we want to address with the system (2), which we address on a conceptual level by providing design principles (3), which we instantiate by developing a prototypic IT system (3 and 4) and which we evaluate (5) in a realistic environment. Activity 6 (communication) is the purpose of this paper. To structure this, we followed an extended publication framework (Heinrich & Schwabe, 2014) based on Gregor and Hevner's framework (Gregor & Hevner, 2013) for presenting design science research activities.

2.2.4 Exploratory Field Study

2.2.4.1 Method and Data Collection

We conducted 11 individual interviews with experienced advisors (in March 2013). The interviews were carried out as semistructured interviews. Besides overarching questions on the process of financial advice giving, specific questions on the consumer education aspect were asked to uncover problems. An example was: *How or by which criteria do you find out how much a customer already knows about the topic the service encounter is about?* We also asked whether or not the advisors try to actually transfer knowledge to their clients, what type of knowledge they transfer, and whether or not they believe that the client's knowledge level is sufficient to make informed decisions. The interviews were conducted at the advisors' workplace.

We conducted focus groups to deepen our understanding of the problems identified in the interviews. Three focus groups were conducted: One focus group with 10 financial advisors, another focus group with 7 'basic advisors' (their predominant tasks were to open accounts and sell simple products), and another focus group with 9 advisory experts and executive staff. These focus groups took place at the university's premise. We extract a set of problems we seek to address with our solution, as well as possible constraints relevant to a solution.

2.2.4.2 Results

The financial advisory service in the observed bank followed a set process. A financial advisory service normally spans two to three meetings with a client to work through a specific advisory case from the outset (establishing contact with the client) until the end (signing of a contract). Most of the advisors favor a procedure in which a client's situation and problem is elucidated in a first meeting, followed by a discussion on possible solutions and products. An advisor then prepares one or more concrete offers and discusses these in a subsequent meeting, which usually takes place within a week.

These statements closely resemble the known schema found in literature (Jungermann, 1999): (1) the description of the problem, (2) the selection of solution options and products (in the client's presence), (3) the preparation of one or more offers with different parameterizations (in the client's absence), and (4) the final appointment to sign the contract. Hence, from a global perspective, this setup resembles an *advice-giving* service encounter, rather than a service encounter based on informed decision-making. However, contrary to our initial expectations, the interviews revealed that client education is perceived as crucial and is generally aspired to by the advisors.

The advisors stated that they sought to close their customers' knowledge gaps, but there doesn't seem to be a process that controls either the delivery or the success of knowledge transfer during the advisory encounter. Advisors are aware of the need to educate their clients, but as several of them noted, it seems to be almost impossible to formally include a block of training and education in an advisory session; instead, most of the advisors reported giving explanations 'on-the-go.' When they sensed a knowledge gap, they either sought to explain this issue during the service encounter or to provide further material on the topic by mail before or after the service encounter. Some advisors also pushed information via mail (e.g. sending them weekly market letters) to clients they perceive as knowledgeable. However, without any guiding process, we argue that many existing knowledge gaps are not detected and therefore not addressed. Furthermore, there is also no implemented process to ensure the effectiveness of such explanations.

We call this the **process problem**: *The process of consumer education, especially when knowledge gaps are assessed, when they are addressed by an intervention and when (if) the intervention's successfulness is verified is performed in overly heterogeneous ways.*

When the advisors described how they actually execute consumer education, a picture of very heterogeneous approaches and goals also emerges: Some advisors thought it sufficient to provide just the amount of information requested by a client, while other advisors restricted their explanations to risks and opportunities associated with the products in question, and still others wanted the clients to really understand their decisions.

We call this the **content problem**: *The selection and depth of relevant content is inconsistent and is guided by the advisor's individual preferences.*

However, several advisors have also expressed doubts that they could reach knowledge levels required for informed decision-making or that they could even reliably verify their degree of success. Many of the interviewed advisors simply asked a client whether or not he or she is already knowledgeable or whether he or she has experience with some products, to assess the knowledge level beforehand. Such an approach has been judged as suboptimal behavior that suffers from framing effects (Oehler & Kohlert, 2009).

We call this the **assessment problem**: *The methods and criteria advisors apply to assess knowledge are inconsistent.*

Concerning the tools the advisors used during a service encounter, free-hand sketches were often drawn to explain products. Some advisors utilized printouts from their back office software solution, while others used information that is freely available on the internet, whereas still others rely on the booklets and other printed material provided by their employer. One advisor also mentioned using analogies to explain difficult concepts.

We call this the **tool and method selection problem**: *Advisors select tools based on individual preferences and rely on third party tools, as the existing ones (provided by the bank) are not perceived as sufficient.*

From these four problems, a picture emerges that a core problem is the individual (chaotic) ways in which consumer education is delivered from an organizational perspective. Without an external reference, the advisors might not even be aware of these inconsistencies or many not perceive them as problems. From the perspective of financial institution, such inconsistencies present a larger problem: These individual or chaotic ways of consumer education do not fulfill the demands of informing the consumer in a compliant way (normative), nor are they quality-controlled or documented.

Besides finding more evidence for the identified problems, the focus groups also helped us to identify a core constraint to any possible intervention to foster consumer education. As the executives stated that client satisfaction is the most valuable quality indicator, and thus any potential solution to that problem, must not endanger with client satisfaction. Executives have also noted that perceived client satisfaction is generally high for their services.

We call this the **encounter satisfaction constraint**: *Any alteration to the current service must not endanger the current (high) client satisfaction level.*

Based on this specific case, we conclude that today's service encounters cannot control for either an actual gain of client knowledge level nor on the assessment of learning progress. Hence we formulate two design goals and one constraint we address and evaluate in the following sections: DG1: **foster knowledge transfer**, DG2: **improve knowledge assessment**, and CON1: **preserve the current client satisfaction level**.

2.2.5 Design Rationales

To address the diagnosed problems and constraints, we developed design guidelines to govern artifact construction and to contribute the design knowledge in a more abstract form so as to provide generalizability.

We generally addressed the *identified problems* by providing an improved process and dedicated learning environments. We addressed the ***process problem*** by spreading out the education activities throughout the decision process and offering specific learning activities directly when a decision is to be made. Thereby, we introduced a process of just-in-time knowledge provisions into the service encounter to enable consumer education directly at the point of decision-making (Chater *et al.*, 2010; Fernandes *et al.*, 2014). By introducing a process that maps the education activities to the decision activities, we also addressed the ***content problem***. In contrast to the current work practices, where content decisions are bound to advisor preferences as well as subjective and vague perceptions of a client's expertise level, our approach offers a fixed set of consumer education modules at the points were the client has to make decisions. Figure 10 illustrates the intended process:

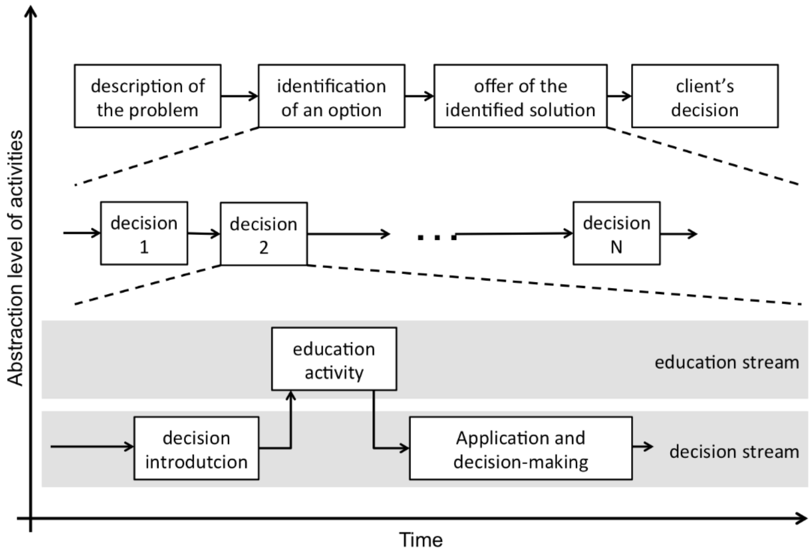

Figure 10: Adapted Model of Jungermann to Support the Alignment of Educational Activities and Decision-making

At the top of the figure, the basic blocks of an advisory session are displayed. During these phases, many decisions are to be made by a client. The client therefore runs through a (previously mostly undefined) stream of decisions. Because our design intervention places an educational stream in parallel with the decision stream, each decision is interleaved by an educational activity. In a first step, the advisor introduces the upcoming decision before engaging in the learning activity. When a sufficient knowledge level is reached, the client can engage or participate in the decision-making activity by applying the gained knowledge.

Hence, we state an **education interleaved decision principle**: *Perform an educational activity at each decision point that seeks to foster the client's understanding of the upcoming decision.*

Based on the modular and interleaved design, as determined by the previous principles, an assessment strategy known as *objective structured practical examination* (Harden & Cairncross, 1980) might be considered. The person to be examined consecutively visits various 'stations' where they can demonstrate a practical skill (Harden & Cairncross, 1980). Mapped to the advisory service, these stations would be the decision points. However, this method requires the candidate to engage in practical (and observable) application of his or her knowledge. We argue that if the learning elements would be interactive, the advisor could observe a client's interaction with the system and thereby also assess his or her level of understanding. Thereby, we address the ***assessment problem***, as we provide a transparent access to the client's learning progress, and we address the ***process problem***, since the assessment happens in parallel to the learning activities. Furthermore, it has been shown that learning through interaction or experiential learning (Kolb, 1984) can also foster the learning outcome in financial service settings (Heinrich, Kilic & Schwabe, 2014).

Thus, we formulate an **interaction-based learning and assessment principle**: *Provide rich interaction opportunities for a client by which an advisor can assess the learning progress as it is performed by the client.*

We address the *tool selection problem* by providing unique learning tools for every relevant decision to be made within our artifact. We propose that hose tools should be designed as *open-ended learning environments* (OELE) (Hannafin, 1994). OELE tools can provide a *learner-centric* and *problem-based* educational approach (Reigeluth, 1999); both are very relevant to this situation, since our core intention is to transfer problem-solving-relevant knowledge and since the learning challenge needs to dynamically adapt to the client's knowledge levels. By providing only one but flexible tool, we relieve the advisor of the task of selecting from a variety of tools.

Hence we state a **modular and open-ended learning** principle: *Provide a single, easily accessible educational tool for each decision to relieve the advisor of the task of* *selecting an appropriate tool. This tool should be open-ended, to dynamically adapt to the desired challenge and depth of the content.*

With the help of these three principles, we sought to address the design goal of transferring more (appropriate) knowledge (DG1). Interaction-based learning and assessment specifically addresses knowledge assessment (DG2). While we cannot explicitly design for client satisfaction, we can evaluate client satisfaction after the tool was used and thereby infer if we have met them (CON1).

2.2.6 Design Solution

We instantiated our design principles by designing a learning environment grounded in the concept of educational micro-worlds (Rieber, 1992) to support advisors and clients in an advisory encounter. These micro-worlds are implemented within a prototype IT system. For a detailed description of how these micro-worlds should be constructed for those settings, see (Heinrich, Kilic & Schwabe, 2014). For evaluation purposes, the prototype encompasses only two micro-worlds: A *portfolio* strategy micro-world and a *savings* strategy micro-world. To create a realistic environment for the evaluation, the prototype also supports all basic tasks of financial advisory services. Hence, we implemented a component for the identification of the client's needs and goals (for details, see (Kilic *et al.*, 2015)), an overview component where the client's goals are mapped to a solution that can also be configured here, and the learning components. All three components were implemented on a 27-inch multitouch device (Lenovo Horizon). We deliberately chose a fund-based saving plan as it is a simple investment product, yet also requires profound decision-making: In order to define this product's properties, the client must decide how much money he or she wants to invest initially as well as monthly. The client must also decide on how the money is to be invested (in terms of asset allocation and associated risk and return expectations, to enable the selection of an adequate fund). Figure 11 shows the state of the system when the decision on the savings strategy and the investment strategy is to be made. In this snapshot, the advisor has already entered a saving strategy as well as a portfolio strategy to introduce the decisions. A first simulation based on the data entered in the previous course of advisory displays the new strategy's effects on future wealth. The system now presents the buttons to enter the corresponding learning modules. The micro-world state is preserved, while the learning environments are entered.

We will now provide details on the micro-worlds and how they are designed.

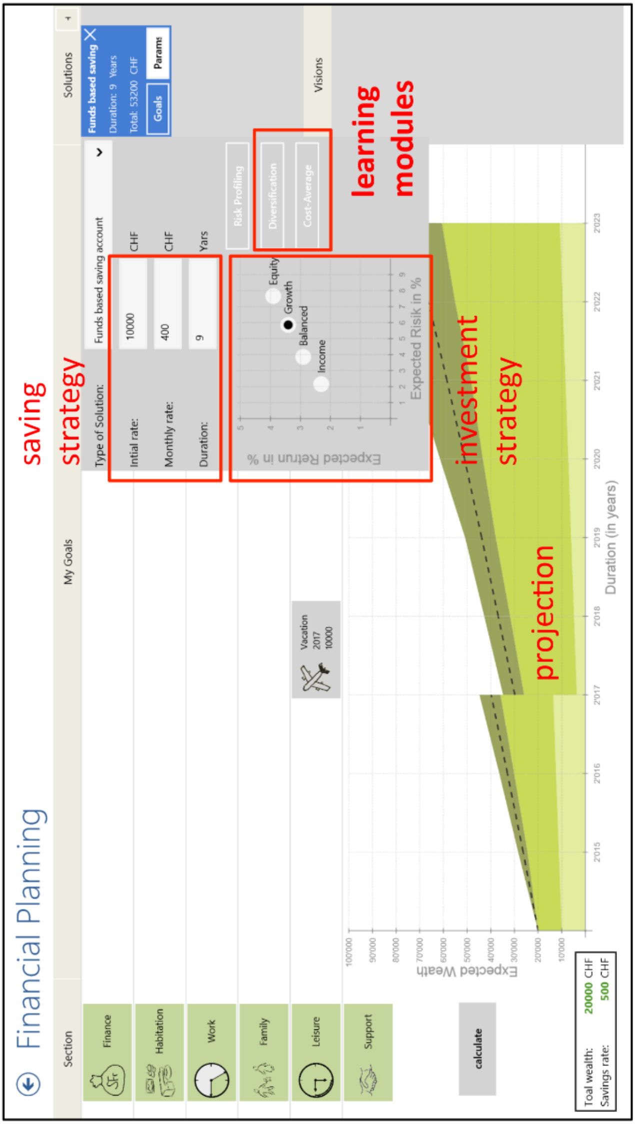

Figure 11: System in the State of Upcoming Decision-making.

Portfolio Strategy Micro-world

Figure 12 shows the state of the system when the client explores the basic properties of portfolio theory (Markowitz, 1952). We implemented a simple risk-return simulation to enable exploration. The simulation is controlled by the input parameters (on the right), while the simulation output is visible on the left. This resembles the visualization of a basic cause-effect relationship. Thereby, the client explores the effects of diversification by controlling the ratio of stocks and bonds (both risky assets) and the ratio of a fixed deposit amount (the two sliders on the extreme right in Figure 12). The simulation results are visualized in real-time on the risk-return diagram on the left screen side to provide instant feedback. One advantage of the micro-worlds is that they are not restricted to parameter ranges currently found in the real world. In the snapshot, the clients can explore freely what would happen if the value of risky asset classes would correlate (instead of being only loosely correlated under normal market conditions). Thereby, they can explore that the effect of diversification strongly depends on the development of the market.

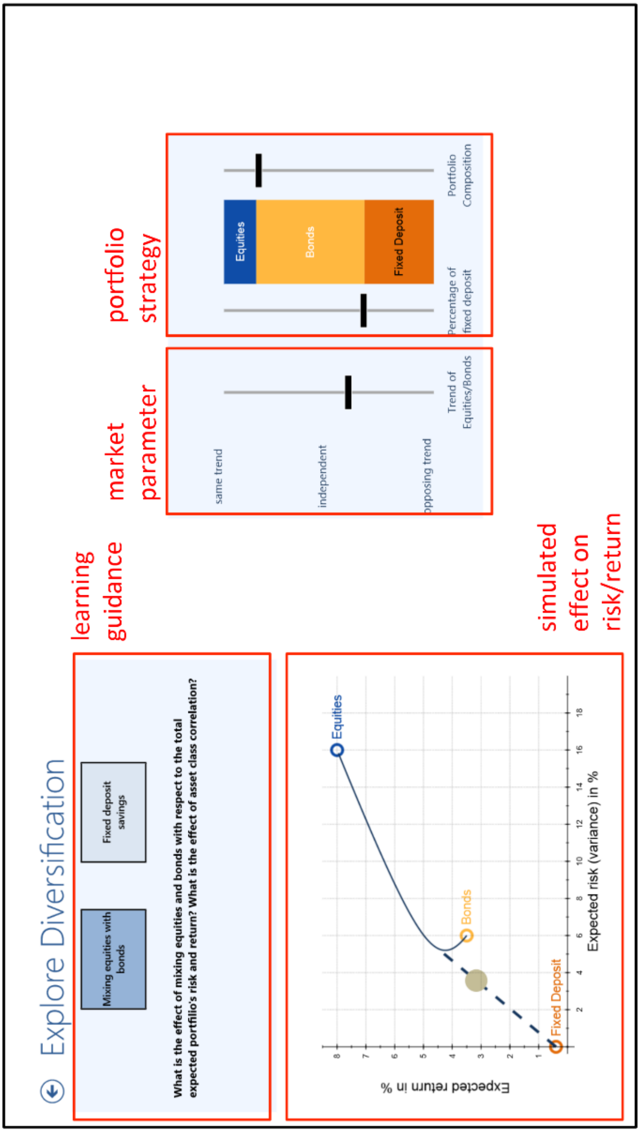

Figure 12: Portfolio Strategy Micro-world

Savings Strategy Micro-world

Once the investment strategy micro-world is entered (Figure 13), the client can explore the basic properties of different investment strategies. The savings strategy question is closely related to the cost averaging effect (Brennan *et al.*, 2005), which is often used to promote certain investment strategies (Williams & Bacon, 1993). The basic assumption here is that when clients regularly buy shares for constant prices (thus getting a variable amount of them), they will automatically buy more shares when their value is low and less of them if they are pricy at the time. It can be proven that this strategy is always superior to a strategy of regularly buying fixed amounts of shares (thus paying a variable price). However, instead of just pretending this behavior, the client can simply explore it in this micro-world without having to relate to any deeper knowledge on the model's mathematical properties (in this case, the difference between harmonic and arithmetic means (Brennan *et al.*, 2005).

With this micro-world, the intention to provide access to this financial model and thus to develop an understanding of what to expect from the strategies and how sensitive these are to changes in the market. The client can experiment with two different investment strategies in direct comparison (strategies for investor A and investor B, at the top right of the screen). These strategies contain a parameter for the initial investment and the amount of regular investments. As the whole comparison of different investment strategies is most interesting when both investors have invested the same amount of capital but in the end have a different level of wealth, useful presets are given as a starting point.

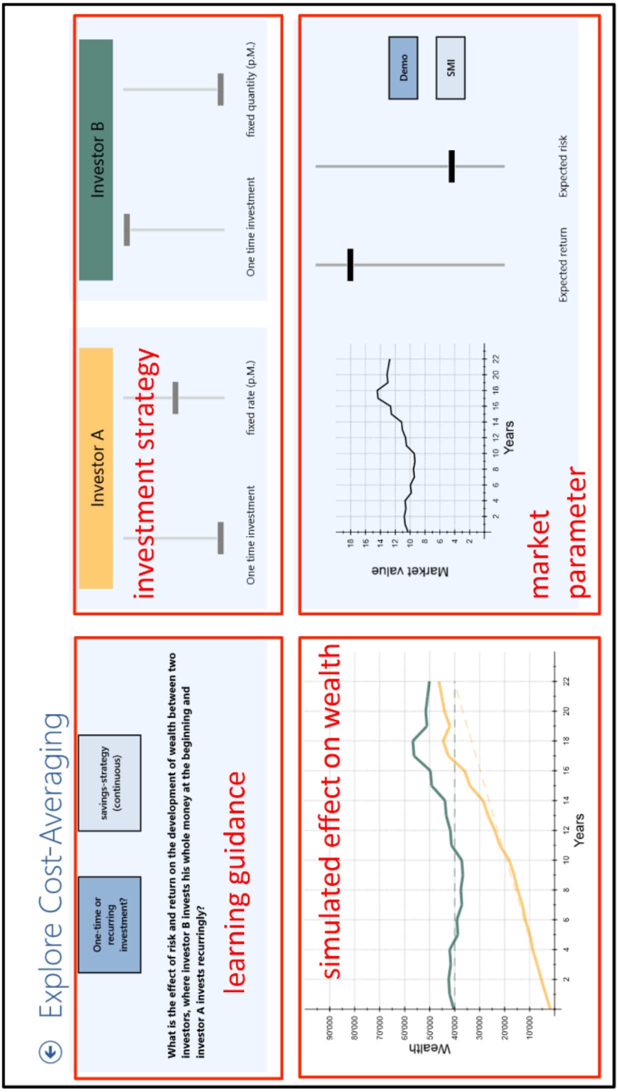

Figure 13: Investment Strategy Micro-world

The learning goal of this simulation is to teach an understanding of how strongly investment strategies are influenced by – unpredictable – market development. Therefore, the client controls a fictional future market by independently setting the fictional market's volatility and returns. The simulation dynamically adapts to these parameters and updates the simulated wealth development accordingly. Figure 13 shows such a scenario where the participants have selected a case with a relatively high expected return and medium volatility. It is clearly visible in the simulation that investing all the money is a superior strategy in this case.

2.2.7 Evaluation

The purpose of this evaluation is to assess the utility of our design guidelines. As we evaluated all design principles in one single instantiation, we cannot assess the utility of single principles but we can provide empirical evidence of their utility in total. Therefore, we will assess whether we met our design (sub)goals and constraints of (1) raising the client's knowledge, (2) fostering the advisor's assessment capability, and (3) retaining the client satisfaction level.

2.2.7.1 Evaluation Design and Data Collection

We designed our evaluation as a **direct comparison** of a **traditional service encounter and our IT-supported counterpart**. The bank associated with this project nominated **12 experienced financial advisors**. On each day of evaluation, two advisers came to the university and took part in the tests. All advisors received a 20-minute video training several days before and were also trained hands-on for 60 minutes with the device on the day of evaluation. Each advisor conducted six sessions, of which three were traditional service encounters and three were supported by our IT solution.

Thirty-six undergraduate students from the business informatics course volunteered to participate in the role of the clients. Each student was equipped with a **fictional scenario**: They were told to expect an advancement of heritage of CHF24,000 (approx. US$27,300) and a monthly payment of CHF300 (approx. US$340) for the next 10 years. The evaluation participants were also told to envision two concrete goals – one in the near future and another in the far future they want to realize with this money. Besides these instructions, they were asked to not engage in any sort of role-play and to behave naturally. The participants were not compelled to stick to their real financial situation for reasons of data protection.

Each participating client received two treatments: One conventional financial advisory service and one service, supported by the described micro-worlds environment. Each treatment featured a different topic to be explained by the advisor. All treatments (classical, IT-suuported, Learning-Topic One, Learning-Topic Two) were permutated.

For each of the two financial concepts (covered by one micro-world each), we derived two questions each, targeting these concepts' cause-effect relationships. We primed the clients with these questions to reliably trigger the educational activities in both treatments. An example question was: *Is it wise to invest all money at once, or is a monthly investment better?*

We created a new questionnaire to measure the actual **knowledge differences**. Established questionnaires for measuring financial literacy (e.g. Chen & Volpe, 1998; Volpe *et al.*, 2002; ANZ Bank, 2008; Calcagno & Monticone, 2011) are too broad and were not applicable to students, as they have a better prior education (e.g. in mathematics). The topics covered in our questionnaire were based on the material the bank supplies to their clients (brochures). We formulated four questions (covering one cause-effect relationship) that we handed out to our subjects before the treatments, to prime them. Based on these questions, we derived four statements each. These statements could be either wrong or correct, and participants were also allowed to answer *I don't know*. Our final instrument consists of eight statements per learning topic (a total of 16 questions). An example for a corresponding statement was: *If the* *expected return is positive, a recurring investment is better than an immediate one-time investment*. The same test battery of eight questions was used before and after each treatment. The learning outcome was operationalized as the difference in correctly given answers.

We let the advisors subjectively rate client knowledge levels on a five-point Likert scale after each treatment, to measure **assessment capabilities**. An improved assessment capability should lead to a higher correlation between the estimated knowledge level and the measured knowledge level.

According to the constraint of retaining client satisfaction, we measured the perceived **satisfaction** using the instrument from the yield shift theory (Briggs *et al.*, 2008) with a five-point Likert scale. We measured the satisfaction with the service as a whole, as well as with the system's three major components: needs elucidation screen, financial planning screen, and learning screen.

2.2.7.2 Evaluation Results

As described in the evaluation design section, the three variables measured were the objective knowledge levels, the assessment capabilities, and the satisfaction levels are presented in the following three sections.

Knowledge transfer

Overall, a knowledge transfer gain can be shown for the IT-supported setting, in contrast to the conventional setting (baseline). After the treatments, the participants could on average answer more questions correctly than before the treatments. We measured the knowledge gain by subtracting the number of correctly answered questions before the treatment from the number of correctly answered questions after the treatment. The participants gained 0.78 correct answers ($s = 0.29$) in the conventional setting, compared to 1.72 correct answers ($s = 0.33$) in the IT-supported encounter (Figure 14). A paired-sample one-sided t-test [$md = 0.944$, $t(35) = 1.98$, $p = 0.028$] confirms that the IT-supported encounter leads to a significantly higher knowledge gain than its conventional counterpart.

For both learning episodes (LE1 and LE2), participants profited from the IT system (see Figure 14). The lines connecting the data points represents the within-setting of the treatment groups (green group: LE1 conventional and LE2 IT-supported; blue group: LE2: conventional and LE1 IT-supported).

The participants spent on average 6:06 minutes (sd = 3:17) in the micro-worlds. In particular on average 4.43 minutes for LE1 and 7.24 minutes for LE2.

Assessment of knowledge

In general, we cannot find a significant correlation between the advisor's estimation of the client's knowledge levels and the actually measured levels, neither in the IT supported (Pearson, $r = 0.181$, $n = 35$, $p = 0.297$) nor in the conventional setting (Pearson, $r = 0.252$, $n = 35$, $p = 0.144$). Furthermore, the advisors' predictions of the knowledge levels do not correlate with the delta of client knowledge for the conventional setting (Pearson, $r = -0.048$, $n = 35$ $p = 0.784$). However, there is a significant correlation between the predicted knowledge levels and the actual delta of knowledge (knowledge gain) in the IT-supported sessions (Pearson, $r = 0.374$, $n = 35$, $p = 0.027$).

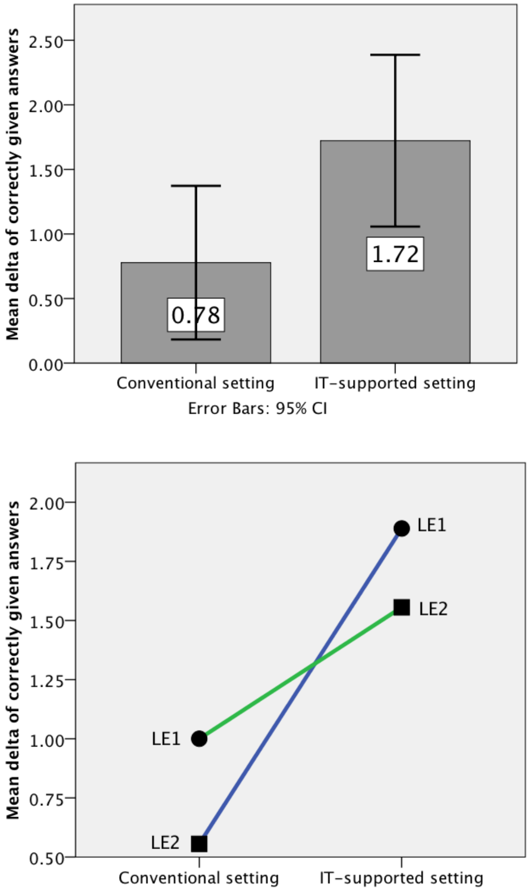

Figure 14: Average Learning Outcomes Comparing Conventional and IT-supported settings (top) and the Same Measurement Itemized by the Separate Learning Elements (bottom)

Satisfaction

Neither clients nor advisors perceived significantly different satisfaction levels for the complete service encounters, regardless of the treatments. For the customers, the satisfaction level was m = 3.77 (s = 0.13) for the conventional setting and m = 3.68 (s = 0.12) for the IT-supported setting. A paired-sample t-test showed that this small difference is not significant (m = -0.08, t(35) = -0.45, p = 0.66). Advisors rated their satisfaction level m = 4.13 (s = 0.21) for the conventional treatment and m = 4.03 (s = 0.21) for the IT-supported counterpart. Again, this small difference is statistically insignificant, as a paired-sample t-test revealed (md = -0.1, t(11) = -0.307, p = 0.77). The individual satisfaction levels for the system's components were: m = 3.23 (s = 1.02) for the needs elucidation screen, m = 3.69 (s = 0.76) for the financial planning screen, and m = 3.75, (s = 0.70) for the learning screen.

2.2.8 Implications and Conclusion

We sought to design a service encounter that utilizes consumer education in order to raise client levels of decision-relevant knowledge. Concerning our evaluation, we can report that we met this goal, at least in our laboratory setting. Concerning the derived design goals, we can provide empirical evidence that the technology-supported service encounter can foster **knowledge transfer** while retaining the current client satisfaction levels. Furthermore, the participants only spent around 6 minutes in the micro-worlds; we therefore argue that this consumer education method is justifiable even under the severe time constraints present in these services.

However, we could not jet met the goal of fostering an advisor's capability to **assess his or her client's knowledge level**. However, there are other indicators why this has not yet worked. We could not show a significant correlation between the estimated knowledge level and the measured knowledge level. However, the advisor's estimation of the client's knowledge level correlates significantly with the measured learning progress of the clients in the IT-supported settings. Since this correlation was not found in conventional settings, we argue that the micro-worlds approach provides an access to the learning progress rather than an access to the absolute knowledge level. We suspect the advisors of rating client knowledge levels higher when they have the impression that they could transfer much knowledge. However, as the absolute knowledge levels are of great interest for reasons of compliance (WpHG, 2011), further research is needed in this area.

Regarding the **client satisfaction level**, the results are presently inconclusive. The clients did not rate their satisfaction level significantly different for the two treatments. We can therefore argue that we met the constraint of preserving a satisfaction level comparable to the traditional service encounter. But the students rate the learning environment with the highest satisfaction value, compared to the system's other parts. Since the absolute satisfaction value with the learning environment was above the total satisfaction value with the service, we argue that the learning modules were an appreciated and accepted component with the potential to positively influence service satisfaction as a whole. Further research is needed on this aspect.

This article contributes to literature, as we applied micro-worlds-supported consumer education (Heinrich, Kilic & Schwabe, 2014) in a realistic financial service encounter setting. We answered the call for action to implement simulation-based and experience-based systems (Bradbury *et al.*, 2014) in real service encounters. We also followed the advice to deliver knowledge just-in-time when it is needed (Fernandes *et al.*, 2014). The results suggest that knowledge transfer during the service encounter (Chater *et al.*, 2010) can work if the right tools and training procedures are utilized. We thus present an alternative approach to this problem than providing additional documentation (Chater *et al.*, 2010; WpHG, 2011), which is known to fail (Chater *et al.*, 2010). In contrast to the argument that approaches to fostering informed decision-making are not worthwhile because a complete transformation of an illiterate client into an informed decision-maker is illusive (Jungermann, 1999; Oehler & Kohlert, 2009), the spirit of our approach is that any additional relevant concept that is well-understood by clients can help them to select the right solution. By aligning the educational activities with the decision-making process, we naturally offer a minimal set of topics and information required for the decision at hand. This reduces the risk of information overload (Oehler & Kohlert, 2009) and respects the time constraints in service encounters (Oehler & Kohlert, 2009), since no unneeded knowledge is transferred. While we cannot solve the problem that the client does not know all possible solution options but, with the help of interactive micro-worlds, we can at least ensure that the client sees all relevant options at each decision point. However, we perceive this situation as superior to the current work practice (Jungermann, 1999). In the range of possible client involvement in decision-making (*from perfect agent* to *informed decision-maker*) (Gafni *et al.*, 1998), we argue that we can shift the client's position towards the *informed decision-maker* – which is congruent with our initial objective.

2.2.9 Limitations

The main limitations of this article are related to the method of evaluation. The system was evaluated in a laboratory setting, thus lacking the real-world situation of making decisions about real money. However, we would assume an even higher interest by clients to acquire the relevant knowledge in such an environment. The advisors also had access to the micro-worlds before the evaluation for training purposes. Thus, they might have already acquired and prepared strategies to cope with the educational tasks. Furthermore, we provided our subjects with questions and advised them to ask these during the service encounter. In doing so, we had no information on whether those topics would have been addressed in the traditional unsupported encounter outside our test environment.

However, we argue that these limitations do not weaken the results, since they also effect the baseline treatment (conventional setting). We had to raise the difficulty of learning topics to match the students' knowledge levels. This also does not weaken our results, as in practice we expect many more (and less complex) relationships worth explaining.

2.3 Enabling Relationship Building in Tabletop-supported Advisory Settings

(CONFERENCE PAPER)

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Abstract: Recent research has shown that financial advisory encounters can successfully be supported with IT-artifacts. Tabletop scenarios, for example, can increase the transparency of the advisory process for customers. However, we have also had the experience that the relationship quality as experienced by customers can suffer severely when IT-artifacts are introduced. Based on these experiences, we developed guidelines for both, the artifact-design itself as well as for the environment in order to avoid this effect, and implemented them in one of our prototypes. The evaluation reveals that these measures proved to be effective. With the reported study, we seek to enhance our design knowledge of IT-supported advisory scenarios with a special focus on

relationship building. In a larger context, we argue that the use of IT during sensitive face-to-face encounters will be of growing significance in the future but, as yet, is hardly understood. We make a contribution in this area with our generic requirements, design principles and evaluation.

Author Keywords: Tabletop, Relationship Building, Advisory Scenario
ACM Classification Keywords: Design, Human Factors, Economics

2.3.1 Introduction

An advisory encounter is a crucial social process often taking place between the representative of an institution and a client. There are a number of different conceptualizations of the advisory process (see (Schmidt-Rauch & Nussbaumer, 2011) for a discussion of different perspectives). In a general sense, one can describe an advisory process as the interaction between two persons, where one supports the other in solving certain problems for reaching certain decisions. Advisory encounters are interaction scenarios that have been known for a long time in the areas of medicine, law or sale.

Recent research has demonstrated that these kinds of advisory scenarios can successfully be supported by IT-artifacts (Novak, 2009; Schmidt-Rauch & Nussbaumer, 2011). For example, Nussbaumer et al. (2012) conducted a number of experimental tests in which the perceived transparency of a financial advisory process could eventually be increased. These experiments, however, showed that the quality of the information that is exchanged between the advisor and the client is not the only crucial factor; rather, the relationship between the client and the advisor can considerably suffer because of the introduced IT-artifact.

This is especially problematic because the quality of the relationship is a crucial factor for the advisory process. According to Jungermann (1999), the social dimension of these interactions is at least as important as the information that is exchanged between the client and the advisor.

The crucial aspect of IT influence on relationship building in such sensitive face-to-face advisory scenarios has hardly been addressed by previous researchers. In addition, we lack empirically-founded design knowledge how these scenarios are to be conceptualized and implemented. This holds especially for the emerging technology of tabletops which are expected to change the advisory setting in many areas. Accordingly, we pursue the following research question: *How can we enable relationship building in a tabletop-supported advisory setting?*

By answering this question, we contribute to the design knowledge on sensitive face-to-face scenarios that are crucial in many areas such as financial transactions, legal advice and health issues. Based on the experiences of the evaluations in the financial advisory area, we develop a number of generic requirements and design principles to support relationship building between an advisor and a client. In this paper, we further demonstrate, how these design requirements and principles can be implemented in a tabletop supported advisory encounter. In an analysis of the time, spent for relationship building (mutual face gaze) we compare two tabletop systems: Prototype 1 that does not implement our design requirements and principles and Prototype 2 that does. The evaluation reveals that our guidelines prove to be effective.

2.3.2 Background

Popular lore claims that there is no second chance to make a first impression. Indeed advisory scenarios are sensitive social interactions which can set the tone for the interactions to come. This is especially the case if the two parties meet only a few times or only once. The role of relationship has been intensely researched in the background of services selling (Crosby *et al.*, 1990) and e-Commerce (Papadopoulou *et al.*, 2001). Results from that research indicate that the relationship between seller and client is crucial for future sale interaction.

In our research, we focus especially on face-to-face advisory encounters in the financial area. These situations are characterized by the fact that the advisor and the client meet only a few times. Thus, the advisor does not have much time to win the respect and trust of the client. Misunderstandings, irritations or a negative personal atmosphere can hardly be corrected.

In this context, by relationship building we refer to the establishment of a trustful connection in which the client feels taken seriously, having his needs attended to and being treated respectfully. Overall the client should feel comfortable to reveal information that is important for the solution or decision making process.

In such a setting, establishing trust is key to a successful collaborative service encounter (Jungermann, 1999). Advisors are trained to establish and maintain a personal relationship, and, for this reason, have thus long resisted using any technology during the actual service encounter, as they are afraid of interference (Schwabe & Nussbaumer, 2009).

2.3.2.1 The role of IT-artifacts in advisory encounters

Advisory services are normally performed in a structured way. In most cases, an investment advisory service will include the following steps: understanding the customer's situation and needs, analyzing her risk preferences and capability, proposing a strategic asset allocation to different asset classes (such as shares or bonds) and selecting specific products (c.f. (Jungermann, 1999) for an explicit phase model).

Although Stewart et al. (1999) proposed collaborative interfaces for face-to-face sales-oriented collaboration, few studies have been undertaken, despite a rising interest in the marketing literature. There, the concept of value co-creation proposes a joint configuration as solution (Prahalad & Ramaswamy, 2004).

Apart from that, literature offers several good reasons to support these encounters with appropriate IT-artifacts:

- It has been shown that IT-artifacts can enable the customer to actively participate in the creation of a solution matching his problems (Schmidt-Rauch & Nussbaumer, 2011).
- The IT-system can make the encounter more transparent by sharing information between client and advisor with the help of a shared artifact (P. Nussbaumer *et al.*, 2012).
- (IT-)Artifacts can support both clients and advisors in the process of "common objectification" (Weber, 2000). Weber et al. (Weber, 2000) describes common objectification as the act of sharing individual knowledge and expertise through materialized items created by the group members. An IT-system can provide such a shared information space to support this task.
- By providing a virtual form of reality, IT-artifacts can also foster efficient knowledge transfer by enabling situated learning in general (Herrington & Oliver, 1995) and also within the advisory encounter (Heinrich *et al.*, 2012).
- IT-artifacts that are used by both advisor as well as client can be a valuable tool to document important information for later advisory sessions or services [WpHG][2].

IT-artifacts like tabletop systems (in contrast to other display types) can help to seamlessly integrate traditional use of paper (e.g., proposed by (Bonnard *et al.*, 2012; Steimle *et al.*, 2010)), which might still be required in such settings.

IT usage, however, also has its downsides. While necessary to achieve goals effectively, IT usage does consume precious time that could be spent otherwise in interpersonal communication. Thus, the more heavily these tools

[2] WpHG: § 34 German Securities Trading Act

are used in the advisory situation, the less time there is available for relationship building.

2.3.2.2 Previous research in supporting face-to-face interactions with regard to relationship building

The connection between working with an artifact, as well as establishing and maintaining a personal relationship, has been an important design issue in CSCW research for more than two decades: "Successful technological augmentation of a task or process depends upon a delicate balance between good social processes and procedures with appropriately structured technology" (Ellis *et al.*, 1991). Very early on, the importance of maintaining eye contact was a key challenge for collaborative rooms (Lewe & Krcmar, 1991). In those days embedded solutions connected single-user computers into a physical conferencing table. Working with these multi-user interfaces turned out to be challenging, as users had to align the actions of others into their own mental models. In consequence, systems were designed for aligning artifact related work with eye contact during distributed collaboration (Mantei, 1988; Nguyen & Canny, 2005). The importance of eye contact for interpersonal relations is also reflected by the literature from psychology: Research shows that eye contact can influence the interplay between two persons on various levels. For example, eye contact (see Kleinke (1986) for a comprehensive summary on this research) indicates whether a person is paying attention to a certain situation, whether a person is perceived to be competent (more eye contacts are associated with more competence) and whether a person is perceived to be credible (more eye contacts are associated with more credibility). In addition, eye contact is generally perceived as an indicator of how much a person is attracted to another person.

Furthermore, eye contact serves as an important coordination function for turn taking in communication. For example, a speaker may hold a longer gaze at a person to indicate that he/she is done speaking and that it is the other person's turn to speak. This indicates that an IT-artifact can alter or disturb a communicational setting on a relatively subtle level. The participants might then develop a feeling of discomfort or confusion without really being able to describe the cause of this problem.

With the advent of large interactive displays, researchers started to focus on face-to-face interactions with ″single display groupware“ (Stewart *et al.*, 1999). Using a single display reduced the cognitive effort of synchronous collaboration, as all participants could directly observe the actions of their collaborators. But not all display types seam to work equally well in service encounter settings: Regarding standard PC-systems, Novak et al. (2009) have shown that a service encounter, supported by a standard PC-monitor, can even worsen the perceived information asymmetry. Regarding large displays, Rogers et al. (2004) found, that horizontal oriented surfaces (like tabletop systems) foster cohesive group work far better, than vertical displays or standard PC-monitors. Tabletop environments, have further often been used in other group settings as a single shared artifact and been credited for their ease with interpersonal communication (Haller *et al.*, 2005). Researchers reported a significant increase in eye contact in contrast to using a desktop monitor as single display interface (Inkpen *et al.*, 2002). Further, a tabletop system closely resembles the known working environment to which clients and advisors are used to.

Tabletop computers can also ease aligning artifact manipulation and non-verbal communication (Tse *et al.*, 2007). The increasing sophistication of tabletop computers appears to be the solution for Scott et al.'s (2003) design guideline: ″Technology that provides little or no overhead to performing or switching between activities would allow users to transition easily between activities, focusing instead on communication.“ However, as we will show in this paper, the introduction of tabletop systems alone is not sufficient to realize successful relationship building. Further requirements need to be considered.

For tabletop activities in general, people favor to sit opposite to each other (Scott *et al.*, 2003; Sommer, 1969), and thus could establish eye contact by just lifting their heads and/or their eyes. Despite some advances of a face-to-face seating arrangement (MATSUSHITA *et al.*, 2005), the orientation of written information on tabletop computers remains an unsolved problem when users sit on opposing sides of the table. Thus, in recent publications (Shaer *et al.*, 2011; Tse *et al.*, 2007), the settings comprise more people sitting in a 90 degree angle or beside one another when participants want to collaborate and use written information. This is also in line with the research of Wallace et al. (Wallace & Scott, 2008), that describes that an adjacent (90 degree angle) seating arrangement is preferred over a face-to-face seating arrangement when working collaboratively. This seating arrangement appears to be a good compromise to support comprehension, coordination and ownership of objects (Kruger *et al.*, 2003). This aspect is also related to the research on proxemic interaction and (IT-) artifact use as, for example, presented by Ballendat et al. (2010). Proxemics describes how people interpret spatial distances to mediate relationships to other people and objects (Hall, 1966). This line of research underlines the importance of environmental variables for the interaction between persons and between persons and artifacts. Up to now, this research, has been directed at larger changes in body movement, for example, when a person walks and her interpersonal distance to other persons or objects is changing (e.g. from the ”public” distance to the ”personal” distance). The aspects of body position we are focusing, on is on a smaller and more subtle scale. We will show how small modifications of body and head position in a face-to-face situation can influence the relationship between these two persons.

Based on this background, we do not limit our study to the user interface (UI) only. While being a central element of the interaction, the UI is only one component that influences the behavior of clients and advisors. One also needs to consider additional aspects, such as body positions or the questions what users do when they are not interacting with the artifact (Ballendat *et al.*, 2010). Thus, our analysis will target not only the UI but the advisory setting in general.

2.3.3 Naïve Deign and Evaluation of Prototype 1

In 2010, we started a joint research project with a major Swiss bank on improving their investment advisory service for their affluent customer segment (50’000 – 500’000 CHF). In the course of this collaboration, Prototype 1 was developed and tested. The main goal of this prototype was to improve the quality of the advisory process. One crucial aspect in this context was the transparency of the process and the exchanged information (P. Nussbaumer *et al.*, 2012).

We used a tabletop system to provide a shared artifact workspace (Schmidt-Rauch & Nussbaumer, 2011). The prototype was designed to support financial advisory encounters within the property of the bank. Since it was not our primary goal to remove all forms of paper from the advisory process but to have it co-existing with an IT-artifact, a tabletop system provided a reasonable working environment that supported both styles at the same time. Note-taking especially was an example of key use of paper in this scenario. A tight and seamless integration (as mentioned in section 2.3.2.1) seamed not necessary for the purpose of note-taking.

The prototypes and test scenarios described in the following sections have also been published in Nussbaumer et al. (Nussbaumer & Matter, 2011; P. Nussbaumer *et al.*, 2012) when researching the transparency of the process. In this paper, we focus on aspects of relationship building in these experimental scenarios that have not been published previously. To this end, we draw on additional data analysis and we explicate the design requirements and the design principles that were established with regard to the relationship dimension.

User Interface: The prototype was built on a Microsoft Surface table, intended to be used as a single shared artifact by both client and advisor. The user interface design of Prototype 1 guided the clients and advisors directly through a suggested advisory process. Each step of the advisory process (e.g., Personal Data, Risk Analysis, Financial Strategy, etc.) was supported by a dedicated screen. On top of the screen there was a navigable process map indicating the current step in the context of all the other steps. We call this the "slide-metaphor," as the visualization is similar to the way information is presented in PowerPoint. Figure 16 illustrates the visualization and interaction possibilities while defining an asset strategy. For a full view of the IT-supported advisory environment see Figure 20.

Body Position: During the advisory sessions, the client sat at the long end of the surface table, with the advisor sitting at the short end. The screen was oriented towards the client, i.e., the client could read texts without effort while the advisor had to mentally rotate the text 90 degrees (Figure 15).

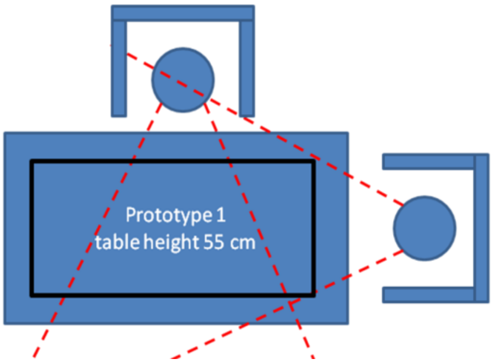

Figure 15: Seating arrangement of Prototype 1 (corner seating).

Evaluation: The prototype was evaluated in a realistic setting with four experienced financial advisors from a major Swiss bank and 12 test-clients. The tested scenario was that of a prospective customer. In the scenario they had to decide on an investment strategy to invest the fictional amount of about US$250,000. All test-clients received two treatments: one traditional pen and paper advisory and one IT-supported advisory encounter (Nussbaumer & Matter, 2011). Half of the participants started with IT-supported advisory service, while the other half started with the traditional setting.

The IT-supported sessions were recorded on video. To compare the two experimental conditions, we conducted interviews in which we asked the participants about their experiences with the IT-supported and the traditional advisory scenarios. We analyzed the recordings of these interviews for all aspects of relationship building as well as for those factors that might affect this relationship building.

Results: The analysis of the interviews revealed that many participants referred to the relationship aspect of the situation. Out of 12 participants, ten participants mentioned this aspect in some form. They pointed out that they were too focused on the artifact, extremely distracted, and that the interpersonal contact without the artifact was more pleasant. One participant described this as: ″I felt that I'm not in the focus, but the computer is″; another one pointed out, ″It's like a triangle relationship, the advisor and table on one side and me on the other side.″
Additional feedback included: ″The traditional setting was more personal; in the IT-supported setting it felt like the table was in the focus not the advisory service.″ ″During the IT setting, the personal aspect was lacking; everything went very quick, it would be better to somehow use it (the system) cooperatively.″ ″The computer appears to be in between.″ ″The most annoying was that he (the advisor) looked at the artifact, instead of looking at me.″

In addition to this aspect, half of the participants also commented on aspects of distraction. Here, the participants described that there was so much information that they felt overwhelmed and were overly fascinated by the artifact. One participant reported: ″You have to wait a while before you can say something.″ A second one felt overloaded with information coming from two sources: ″A lot of information from the table, and the advisor and I have to handle this.″ Some also felt inhibited, stating: ″One was so fascinated by the table that one did not ask questions.″ Finally, the surveys revealed that the participants preferred the traditional setting to the artifact-supported setting (Nussbaumer & Matter, 2011).

2.3.4 Problem Identification and Generic Requirements

The literature (Haller *et al.*, 2005) describes numerous settings in which partners successfully collaborate while using shared artifacts on table-top computers. In our first evaluation, however, this did not seem to be the case. Based on the evaluation described in the previous section, we conclude that the scenario described for Prototype 1 does not lead to a functioning relationship between advisor and client in many cases. As seen in the evaluation, many participants accredited the presence of the IT-artifact for the disturbed interpersonal relationship. Therefore, our main solution objective is:
Solution Objective: Establish effortless relationship building in IT supported face-to-face advisory encounters.
With ”effortless” we mean that it did not take the participants noticeable effort, i.e., more effort than s/he was used to from similar unsupported situations.
Similar to the work of Haller et al. (“Communication space” and “Task space”) (Haller *et al.*, 2005), we introduce the notion of spaces: “relationship building space” (RBS) and “artifact work space” (AWS) (Figure 17). Both RBS and AWS are physical spaces persons can use in their sole discretion. The AWS is defined as the space the persons look at if they want to work with the artifact. RBS on the other hand is defined as the space the persons look at when they want to engage in relationship building. The RBS therefore resembles the space where relationship building is possible from an external point of view.

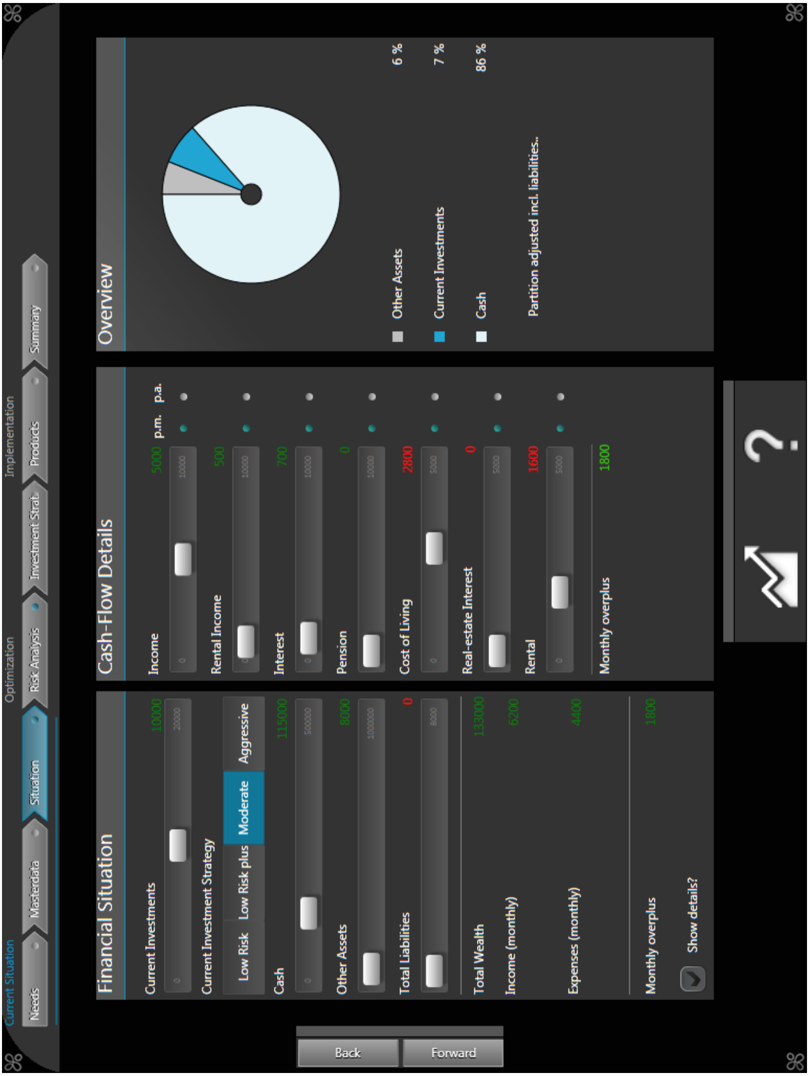

Figure 16: “Slide-metaphor” of the Prototype 1 (full extent of tabletop display, original interface was in German language).

However, humans are only able to focus on a single point in space at any given time. Thus, we end up with a mutually exclusive three state model of each participant being in one of: 1) in an artifact state (the person is focused on the artifact itself); 2) in a relationship state (the focus is on the other person, probably seeking eye contact), or 3), the person is looking somewhere else.

To visualize these states and transitions, we developed a state model (Figure 17) for single or two person situations. This model describes the situation where one participant wants to change its state from being in AWS to RBS. As discussed in the literature section, people feel the need to engage in the RBS, for example, to signal a misunderstanding (Kleinke, 1986), to ground their communication (Clark & Brennan, 1991) or to assess the personality of the other person. We assume relationship building to be efficient when both persons are in the RBS state at the same time.

In the discussion following, we focus on the transitions leaving the AWS states. We will argue under which circumstances people can enter RBS directly via transition "A" or why they fail and take transition "B" or "C" instead.

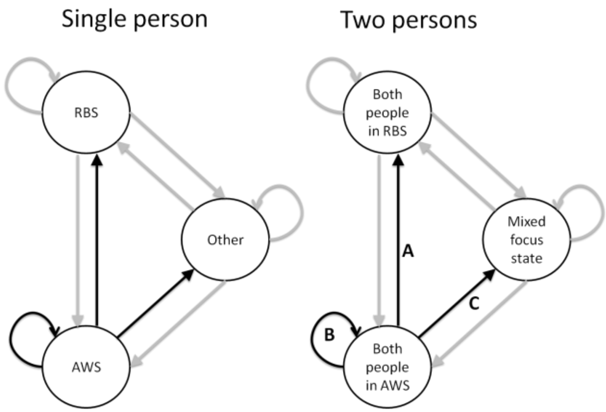

Figure 17: States of focus (left: single person; right: combined model for advisor and client).

The failed relationship building with Prototype 1 implies that the participants did not reach the RBS state often enough or did not stay there long enough. For a successful transition into the RBS state, three things are necessary: First, both participants have to be aware of the existence of that state. Second, to be successful, the transition into the RBS-state has to be a coordinated transition, leading to both participants being in the RBS simultaneously (Transition A, Figure 17). Third, the affordance to transit into the RBS-state has to be low enough for the participants to switch deliberately into the RBS state.

The AWS state is inherently created with provision of the artifact to its users. However, the relationship building space does not seem to instantiate itself automatically. In order to ensure successful relationship building between client and advisor, that space has to be created and maintained throughout the session. Relationship building is not a one-time effort but rather an ongoing procedure running in parallel to the technical task of problem solving and decision making. This implies constant switching between the two spaces.

To motivate people to engage in the relationship building space, they have to be accommodated to it. In many non-IT-supported situations this happens intuitively when two persons interact with one another. However, it seems that this step is easily omitted when people are confronted with an attractive IT-artifact. Lacking such a relationship can hamper any further development of the relationship when using an IT-artifact right from the beginning. The first encounter in such a setting is probably crucial and sets the stage for the relationship that is established between the two. If the RBS is not introduced at the very beginning of the session, the advisor and client lack common ground (Clark & Brennan, 1991).

***Generic Requirement 1**: Initially accustom the participants to the relationship building space and instantiate a basic relationship.*

While interacting with Prototype 1, participants complained about the process the IT-artifact imposed on the interaction between themselves and the advisor. One participant stated: "The process was predefined and it was difficult to ask questions." Another one said: "It should not be like an assembly line – it should not be that standardized." One participant suggested that there should be a period of talking to the advisor before the IT-artifact was introduced.

Even though it was not the intention at the time of development, we enabled the experience that participants as well as advisors followed the pre-given structure of the interface very strictly. As the visualized process had no relationship building related activities, they were simply omitted by the participants. One experience was that a process visualized by IT could have a much stronger effect on the socializing behavior of participants than was intended by the developers. While the process was meant rather to help participants not to forget anything important and to provide some orientation, the participants seemed to interpret the process as an instruction for behavior. Applied to our state model, instead of switching into the relationship building state, they stayed in the AWS state (transition "B", Figure 17). In contrast to transition A and C, transition B was explicitly expressed and visualized within the artifact design itself.

This led to the impression that personal or social aspects do not have any place in the advisory process. This aspect conflicts with the guidelines proposed by Ruth Cohn (2000) for her Theme-centered Interaction Approach: Disruptions have priority, meaning that it does not make sense to continue with a process if there is conflict on a behavioral level. Thus, we formulate the following requirement:

Generic Requirement 2*: Avoid UI designs that bind participants to the artifact space due to a prescribed process.*

In the first setting, the participants were sitting in a 90° orientation to each other. Due to the low table height, they had to bend a little over the artifact. To switch between the AWS and RBS, they had to at least rotate their heads towards each other. To get into a relaxed body position, they had to lean back and thus move their entire upper body.
We assume that these high switching costs hampered the transitions into the RBS. The participants referred to this issue, stating that the situation with the table was not very comfortable. One participant said: “It was disturbing because it [the table] was too low; I had to bend my head over it.” Another one would even prefer to stand. To address this issue, we formulated the design requirement:

Generic Requirement 3*: The physical effort to switch into the relationship building space (RBS) has to be low. Avoid the need for body movement at all.*

Another cause we assume to play a role is that a high cognitive effort can also reduce the ability to grasp the other person’s state. We arrived at this conclusion after hearing the remarks of participants. A number of participants complained that they “had to concentrate too much on the tabletop,” that “the advisor had to concentrate too much on the tabletop” or that “it was difficult to process the information and relate to the advisor at the same time.”
As the interviews reveal, the participants were aware of their own cognitive effort required and the resulting lack of time to personally interact with the

advisor. We assume that the constantly changing screen forced clients into building a new mental model for each screen – probably also trying to keep in mind the connection to the other hidden screens. This led to the effect that their focus was glued to the artifact space in a (subconscious) fear that they might miss something or that they would not be able to orient themselves again after returning from the relationship space. To address the cause, we formulated the design requirement:

Generic Requirement 4*: The cognitive effort of leaving the artifact space has to be low.*

If one person is unaware of the other person's intention to switch into RBS, coordinated state switches are impossible or severely hampered at best. Humans only have a limited peripheral field of vision and a very limited area of focus. The advisor seeking eye contact with the client is probably one of the most important indicators that the advisor is seeking a connection with the client. The client, on the other hand, is irritated when he feels the need for attention when the advisor is engaged with the artifact.
The seating and body position in the first setting did not allow them to focus on the artifact while being able to track the other person's point of focus. The face of the advisor, for example, simply vanished out of the peripheral field of vision when the customer had to look at the center of the artifact. Thus, coordination might have been difficult, often resulting in uncoordinated space switches (transition "C", Figure 17). Therefore we propose:

Generic Requirement 5*: Ensure effortless sensing of each other's space switches, utilizing the peripheral field of vision.*

2.3.5 Design Principles and their Implementation in Prototype 2

Creating and maintaining the *relationship building space*:

To accommodate the person to the *RBS,* we suggest introducing a dedicated small talk phase prior to the artifact related work itself. In addition to accommodating the person to the space, the small talk phase is used to establish a first relationship between advisor and client. Thus, this intervention has actually two goals: Firstly, to make participants aware that a relationship building space exists and that it is accepted or even desired within the "interaction protocol" to switch into this state. Secondly, the two participants establish an initial relationship that makes it more likely for them to return to the relationship building state. This initial relationship should also lead to an interaction in which later disturbances (e.g. a short lack of eye contact) are not experienced as severe by the participants.

Design-Principle 1 *(to address generic requirement 1): Establish a basic relationship in IT-supported advisory sessions with a dedicated small talk phase at the beginning*.

Implementation: For the Prototype 2 evaluation, the advisors were instructed to be seated at the multi-touch- table but to disregard the artifact during the initial small talk phase; rather they should use a physical notepad and a pen to write down useful information during that phase, exactly what they were used to using in the traditional setting.

To overcome the interpretation of the rigid process visualization that no space was available to the relationship building activities, we suggest omitting any direct visual representation of the process.

Design-Principle 2 *(to address generic requirement 2): Omit any visualizations of a determined process and avoid any cue to the next activity in AWS.*

Implementation: To implement the described visual representation, we mapped each activity to a dedicated widget (software tool supporting the activity). All widgets were freely movable but initially arranged in a circular layout (c.f. Figure 18).

Switching between artifact work space and relationship building space:
To enable easy switching between the spaces, we propose optimizing the seating position. This principle therefore addresses the environmental aspects rather than the artifact itself. The benefits of adjacent seating arrangements are described in section 2.3 in detail.

Design-Principle 3 *(to address generic requirements 3 and 5): Place the participants on adjacent sides around the table so that the RBS and AWS are reachable with minimal body and head movement.*

Implementation: For the second evaluation, we raised the table by 15 cm to a comfortable height of approximately 70 centimeters. This allowed the participants to sit in a slightly tilted, diagonal position and use the table as an arm rest. That seating position allowed participants to focus on the artifact while perceiving the other person’s face in their peripheral vision (Figure 19). To switch the space in this arrangement, it is enough to move the eyes only, instead of the head or the whole body.

Figure 18: "Zoom and filter" metaphor of Prototype 2 (original interface was in German language).

To make the interface more stable than the *slide metaphor* style of Prototype 1 we propose using abstraction layers where possible. Abstraction layers also help to reduce the visual complexity of the interface without restricting its functional complexity.

***Design-Principle 4** (to address generic requirement 2 and 4): Always display a complete picture of the situation at all times. Design for a stable UI and restrict visualization changes to portions of the screen only.*

Implementation: The UI of Prototype 2 was designed with a metaphor of "zoom and filter" (P. Nussbaumer *et al.*, 2012; Shneiderman, 1996), where only portions of the screen altered at any time. The interface consisted of single widgets, each addressing one activity. Each widget could extend the level of detail when needed (implemented as seen in Figure 18). With this design, only one widget could change its representation at any time, thus providing a mostly stable screen.

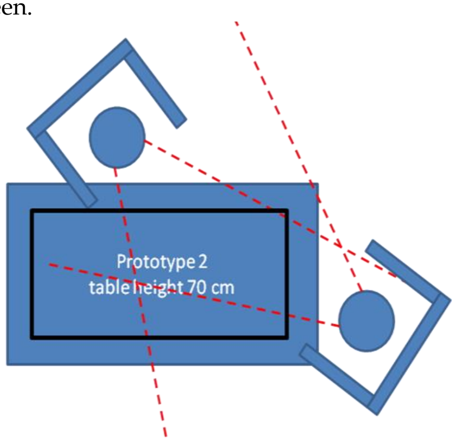

Figure 19: Seating position with Prototype 2 (diagonal seating)

2.3.6 Evaluation of Prototype 2

Prototype 2 was evaluated like the first one. The experimental evaluation involved 24 clients and 12 advisors in a within-subject design to compare the

IT-supported encounter with its traditional counterpart (pen and paper) (P. Nussbaumer *et al.*, 2012). Half of the participants started with IT-supported advisory service, and the other half started with the traditional setting. Again, participants were interviewed regarding their experience with the two experimental conditions; the IT-supported sessions were videotaped and all sessions were observed by members of the research team.

The strong connection between eye contact and relationship development is reported in the literature (Kleinke, 1986), and so we use eye contact as an indicator for being in RBS. However, our video recordings did not allow us to determine eye contacts with certainty; accordingly, we refer to these episodes as “face-gazes.” However, we assume that most of these face-gazes were actually eye contacts.
We conducted a systematic analysis of face-gazing behavior between clients and advisors. Thus, we opted to encode the viewing directions of both the advisors and clients.

All videos were manually encoded by two observers pressing buttons, each button representing one of the current viewing directions for each participant. This procedure was conducted for the IT-supported sessions of Prototype 2 as well as for the IT-supported sessions of Prototype 1. Each IT-supported test session was video-recorded during the evaluations with both faces and the artifact visible in the recording. We analyzed the 12 sessions of Prototype 1 and 12 sessions of the 24 recordings of Prototype 2 in order to have equal sample size.

The three distinct viewing-directions for each participant were “Focus on the other person” (person looking at the face of the other participant), “Focus on artifact” (person is looking at the artifact), and “Focus elsewhere” (person is looking in any other direction (c.f. Figure 20).

We sampled each recording for 20 second intervals out of every minute of video (second 0-20s, 60-80s, 120-140s, etc.). We expected the small-talk phase to have a lot of face-gazing by nature. We thus marked the point when the small talk phase was left and the participants started to work with the artifact.

2.3.7 Results and Discussion

In this section, we first report the results of the interviews followed by the results of the face-gazing analysis. Subsequently, we describe the observed effects of our design guidelines.

Interviews: In contrast to the interviews that were conducted with the participants of Prototype 1, participants of the second evaluation hardly reported any problems with respect to the relationship between advisor and client. Only four out of 24 persons briefly mentioned this aspect (In Prototype 1 10 out of 12 clients mentioned this aspect).

Face-Gazing: Observing the session as a whole, the data show that sessions with Prototype 2 had nearly twice as many face-gazes or eye contacts as did sessions with Prototype 1. Figure 20 shows a state model of the two participants regarding their viewing directions. Face-gazing or eye contact was encoded when both participants looked at each other at the same point in time.

With Prototype 2, participants had an average mutual face-gazing ratio of 19.58% of the time, while they only had 10.75% with Prototype 1 (Figure 21). The difference is significant (two-sided t-test, $T(22) = 3.23$, $p = <.01$).

The difference in the face-gazing ratio could not simply be explained by the presence of the dedicated small talk phase. If excluding the small-talk phase from the sample, the length of the gazes was 17.08% for Prototype 2 and 9.33% for Prototype 1 (Figure 22), but still significantly different (two-sided t-test, $T(22)=2.93$, $p = <.01$).

In addition to this, we analyzed the absolute length of the mutual face-gazing episodes. This analysis revealed that there are more occurrences of longer length face-gazing contacts (10 seconds and more) for Prototype 2.

An interesting side aspect is that the data show that for both Prototype 1 and 2 the advisors in general focused on the clients more often than clients focusing on advisors. They spent over 30% of the session's time looking towards the clients.

Figure 20: States of view when working on the artifact.

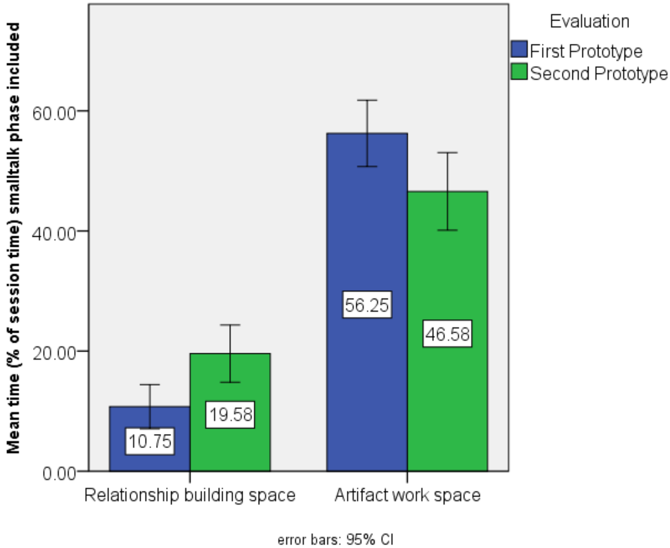

Figure 21: Mean time in the relationship building space with the small-talk phase included.

In greater detail, for Prototype 1 the advisors looked an average of 31.58% of the time towards the client and the client looked 16.83% of the time towards the advisors. For Prototype 2 the numbers were 38.08% for the advisor and 27.83% for the client. The difference for the client is significant (two-sided t-test, $T(22)=3.38$, $p<=0.01$). Without the small talk phase the average face-gazing time was 14.6% vs. 23.6% for the client (two-sided t-test, $T(22)=2.79$, $p<=0.05$) and 30.5% vs. 36.5% for the advisors.

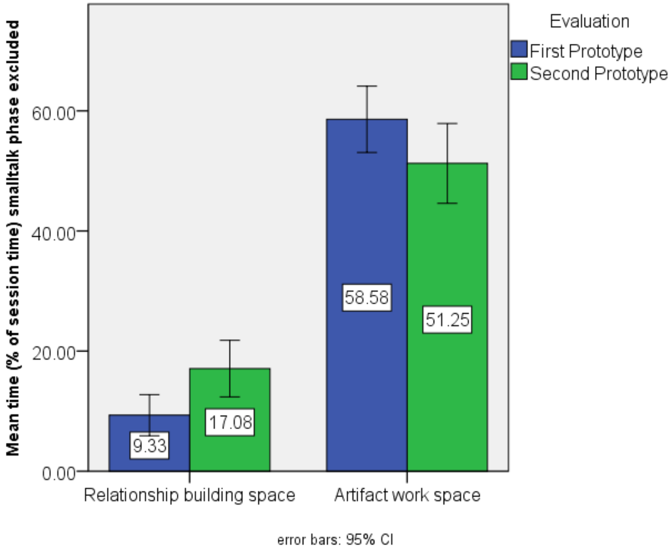

Figure 22: Mean time in the relationship building space without the small-talk phase.

Creating and maintaining the relationship building space:
The idea of having a dedicated small-talk phase at the beginning of the advisory endeavor was adopted well by the advisors. All sessions with Prototype 2 had an extensive small-talk phase (average of 10 minutes) between client and advisor prior to interacting with the artifact.

During that phase we could see a high degree of mutual face-gazing, supporting the assumption that mutual face-gazing moments are desired by both parties in such encounters. The additional dedicated small talk phase alone increased the overall amount of successful mutual face-gazing in comparison to that of the first evaluation. But even when subtracting these episodes from the face-gazing analysis, the situation for Prototype 2 still contained significantly more mutual face-gazing when compared to Prototype 1.

Switching between artifact work space and relationship building space:

The observation of the trials as well as the video recordings revealed the following aspects. The changes in table height had a strong effect on the predominant seating position. Due to the fact that the table was not square and people were seated relatively close to the artifact (in a 90 degree position), it was not possible for customers to focus on the artifact and simultaneously to have the advisor's face in their peripheral view. To gaze at the advisor's face, they had to leave the artifact focus and rotate their heads towards the advisor.
Now, with the rotated seating position of the second evaluation, customers had the face of the advisor and the artifact in nearly the same line of sight. Without the need to rotate their heads, they could sense when the advisor was looking at them and make direct eye contact when they felt it was appropriate.

This altered seating position, we believe, resulting from the change in table height, allowed customers to use the table as an armrest. Apparently, people prefer using a table as an armrest in such situations, as we also observed during the unsupported (pen and paper traditional style) advisory encounters. These situations are sensitive to minute changes in the physical environment (like raising the table height by 15 cm), and the effects can be manifested in the overall impression of the participants.

We assume that the reduced cognitive effort on the part of the advisor as well as that of the client leads to increased chances that eye contact can be established. This is supported by our face-gazing data indicating that the advisor looks more often at the client in the Prototype 2 condition compared to in the Prototype 1 condition. This effect is even stronger for the clients. In the Prototype 2 condition the clients look considerably longer at the face of the advisor compared to in the Prototype 1 condition.

However, we mainly attribute the altered UI for the change in cognitive effort on the client side and the extended training period for the change of load on the advisor's side solely by argument. Since the experiment did not control for these variables separately, we cannot be certain.

2.3.8 Limitations

The analysis we conducted on our experimental scenarios did not allow us to control for all possible variables. Thus, we cannot be certain of the amount of influence of the different variables discussed or the directions of the influences. Our in-depth analysis, however, provides a rich understanding of the situation that would not have been possible in tightly controlled experimental settings.

The experiments were conducted in the Swiss financial sector, and their direct applicability is limited to this sector. We are confident it can be generalized in two directions: The results should be applicable to other Western countries, as underlying issues of principal agency conflicts and trust building are common there too. We believe they can also be generalized to other collaborative settings where establishing and maintaining personal relationships is crucial. Primary candidates are other sales oriented service encounters, e.g., in insurances or travel agencies. Conflict resolution meeting, consensus finding sessions or negotiations may also benefit from our results.

2.3.9 Conclusion

In this paper we described the severe effects of insufficient relationship building when working with IT-artifacts in advisory encounter situations. Based on observations and existing literature, we derived five generic requirements and four design principles that specifically address requirements for successful relationship building. These principles address the design of the artifact itself as well as the environment and process. In a subsequent evaluation with an enhanced prototype, following these guidelines, we found the effects of insufficient relationship building being reduced to the point of not being reported any longer by the majority of the test participants. Therefore, we conclude that systems following these guidelines should be able to maintain the level of relationship building compared to that of traditional settings.

In contrast to related work, this paper not only addresses the physical environment but also focuses on UI design issues related to relationship building. In the interviews we also found evidence that a suboptimal design of the IT-artifact can directly hamper relationship building.

Our contribution should help in the development of future collaboratively used IT-artifacts, thus directly contributing to the research stream of IT supported face-to-face collaboration (Haller *et al.*, 2005).

By addressing the relationship building issue, we also enable practitioners in the finance industry to address a crucial aspect of their value proposition, i.e. a trusting relationship to their clients.

In this contribution, we focus on advisory scenarios, where the customer visits the advisor in her office because we believe that these settings have interesting characteristics from a scientific perspective as well as an increasing importance from a practitioner's perspective. From a research perspective, we helped understanding relationship building while working with IT artifacts in service encounters. For practitioners on the other hand, this contribution could be meaningful to design future systems without hampering the very fragile aspect of relationship building. Advisory scenarios are the central communication channels for several core disciplines in our current service economy, including medicine, law, finance and many sales processes. Advisory settings are always used when the information that is communicated is complex and/or very relevant to the perceiving person. This can mean that high amounts of money are involved as in financial situations or that the risks of certain procedures are very high such as in medicine or in legal advice.
It is therefore very important that the client is well informed to make an informed decision. This includes transferring the information as such, but it also includes the creation of a trustful relationship because the lack of such an relationship will also hamper the cooperation and the exchange of knowledge

and advice (e.g., if persons do not ask relevant questions or conceal important information).

Thus, these kinds of processes are omnipresent in our current economic, medical and legal system with severe implications for the advised persons but possibly also for the advisor in case the advisor process fails. We believe that due to the awareness of the sensitivity of the process, the introduction of IT into these processes has hardly been undertaken.

The complexity of the transferred information, however, as well the challenging learning process that the participants of the advisory process have to go through, makes the introduction of IT very promising for the following reasons: The process of the advisory session can be supported in such a way that no central information aspects are omitted. Core aspects of the knowledge that has to be transmitted can be visualized and animated to improve the understanding of the complex subjects. Finally, the discussed topics can be documented and used to recall complex content after the end of the advisory session.

For these reasons, we expect an increased use of IT in such sensitive areas. These new opportunities, however, also impose new challenges for the design of advisory support systems. If we want to realize the benefits, we have to understand how these kinds of systems impact the relationship building between participants and be aware of the implications for the design. This article seeks to make a contribution in this direction.

2.3.10 Acknowledgements

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* SDFB: swiss design institute for finance and banking

2.4 Coercing into Completeness in Financial Advisory Service Encounters

(CONFERENCE PAPER)

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* As the second author, I substantially contributed to this publication by providing the turn-taking analysis. I further implemented the prototype system and ran the evaluation with equal effort to the first author of this publication.

Abstract: In this article, we report on design insights found during the evaluation of an innovative IT-artifact to support financial service encounters. Relating to previous work in this field, we carefully designed the artifact to omit any visualization and enforcement of rigid process structures, as those had turned out to be harmful. Our main design element was a mind-map-like content hierarchy to capture the client's situation. Surprisingly, we noticed that both clients and advisors talked about every information item visible on the screen just for the sake of completeness. They also followed a sequential process apparently inferred from the content hierarchy. We call this phenomenon "coercing into completeness". This phenomenon negatively

influences the conversation between client and advisor inducing shorter discussion units and sudden, incomprehensible topic shifts. This article contributes an exploration of this phenomenon and its effects on the collaborative setting.
Author Keywords: financial advisory service; needs elicitation; completeness; exploratory research; design research
ACM Classification Keywords: H.5.3 [Group and Organization Interfaces]

2.4.1 Introduction

Performing tasks completely can be an important factor for qualitative work. In medicine, for example, a physician is required to carefully carry out an anamnesis in order to obtain a sound diagnosis. Engineers have to analyze requirements completely in order to design a purposeful solution to the given problem. Factory workers need to perform all steps completely to assemble products. In all those cases a standardization of the workflow can help guiding the ongoing work towards an expected outcome. It can also help to assess the level of work-completion by comparing its status to the workflow's definition. However, if processes are defined in too fine-grained manner, this may lead to acceptance problems, as this restricts process participants in an undesired and unnecessary way (Littler, 1978). Therefore, the level of detail has to be well balanced between optimal guidance and reasonable levels of restriction.

Collaborative settings are even harder to manage, especially if the participants have different opinions on the level of completeness. Financial advisory services, for example, are loaded with different perceptions of completeness. On the one hand, the clients might be primarily interested in having their individual situation and their goals considered completely in order to obtain the best matching financial product. On the other hand, the financial advisor might have his own incentives, and thus his targeted level of completeness might be restricted by the minimum information required to make an offer. In the worst case, the advisor also limits the range of products according to his personal sales goals in order to receive an extra bonus at the year's end. An inherent conflict of interest between the parties is often referred to as "principal-agent-conflict" (Eisenhardt, 1989; Novak, 2009) and implies an associated asymmetry of information (Prahalad & Ramaswamy, 2004; Schmidt-Rauch & Nussbaumer, 2011). Executives from the bank still might be interested in another level of completeness. They might prefer complete standardization of the advisory process in order to deliver constant service quality and to comply with normative regulations. In general, these different levels of completeness are never explicated and only implicitly communicated among subgroups of the participants.

Scholars and practitioners have tried to support those encounters with IT-based tools in order to dampen the information asymmetry by making the process itself and the information processed transparent to all stakeholders (Nussbaumer, 2012). However, it has been shown that those supportive tools have to be designed with great care, as they might otherwise endanger the social setting (Heinrich, Kilic, Aschoff, *et al.*, 2014). An explicit visualization and enforced guidance through a rigid process "was perceived to be authoritative and deterministic, imposing its process structure upon the users and restricting the user's control of the process" (Nussbaumer & Matter, 2011). An implicit process guidance is far superior and even leads to higher levels of perceived process transparency, process control, and higher overall satisfaction with the service encounter (P. Nussbaumer *et al.*, 2012).

We set out to design an IT-tool to support the first and arguably most crucial phase of financial advisory services — namely, the client's needs elicitation. In this initial phase, the current situation of the client is captured as well as his attitudes, preferences, and goals. We designed an advisory-support tool to support this phase. Our main intention was explicitly not to impose any process onto the participants, because we were aware of the different demands of the various stakeholders (clients, advisors, and executives). Based on literature and prior experience with those settings, we opted for a mind-map-like interface to provide maximum freedom with respect to both the process as well as the content used within a service-encounter.

Besides the obvious benefits that our solution has from a management perspective, some participants felt coerced by the tool to adapt the visualized content as process structures and as notion of completeness. We call this phenomenon "coercing into completeness".
In this paper, we introduce the phenomenon of "coercing into completeness" (1) by describing one exemplary context in which it occurs, (2) by describing its manifestation in the particular collaborative setting from the perspectives of the clients and the advisors, and (3) by making conjectures on the reasons why the phenomenon occurs.

Hence, our research questions are:

RQ1: How does coercing into completeness affect the service encounter?
RQ2: Why does coercing into completeness still occur in the absence of any explicit process and progress visualizations within the IT artifact?

The paper ends with a detailed discussion of the phenomenon as well as implications of our findings for the future design of advisory support systems.

2.4.2 Related Work

2.4.2.1 Coercing into completeness in single user contexts

Many companies like Google, LinkedIn, and Dropbox provide a feature called "completeness meter". These kinds of progress indicators give the user feedback on how far he or she is while completing a task. These meters are mostly used to motivate new users to add personal information or to complete activities. Myers has shown that people prefer to have progress indicators (Myers, 1985). Completing a task is intrinsically rewarding. The discrete task completion hypothesis by Skinner states that a completed task is a conditioned reinforce (Ferster *et al.*, 1957). Zeigarnik (1938) has shown that people have a tendency to remember incomplete tasks better than completed tasks. Uncompleted tasks are kept in memory until they are completed. These open tasks cause an uncomfortable feeling or even tensions and stress. People want to resolve this tension. This is called negative reinforcement in operant conditioning (Ferster *et al.*, 1957). People want to remove something distasteful. For example, this effect is used in many mobile operating systems with the annoying persistent badge to motivate us to update our apps or to give attention to new messages. We will usually update our apps because we want those annoying numbers to disappear (negative stimulus). In summary, a progress bar bears both effects at the same time: It is possible to achieve something (positive reinforcement) and to complete an undone task (negative reinforcement).

2.4.2.2 Coercing into completeness in dyadic advisory contexts

Financial advisory services are predominantly delivered in a dyadic setting and can be divided into three phases (Oehler & Kohlert, 2009): "information collection phase", "information phase", and "recommendation phase". During the encounter, the problem space of the client (information collection) has to be mapped with the solution space (recommendation phase) to identify matching solutions (Novak, 2009). For this paper, we focus on the first phase, the information collection phase. At the beginning of the advisory session, an information asymmetry is inherently given because the advisor has insufficient knowledge of the current client's situation. During this first phase of the service encounter, this information asymmetry shall be lowered.

In the information collection phase a notion of completeness depends on the desired modus of advice-giving. Literature describes this as a continuum between two extreme positions: either the "Informed Decision Making model" or the "Perfect Agent Model" (Gafni *et al.*, 1998). In the "Informed Decision Making model", the clients make all decisions by themselves, in contrast to the other model, where the advisor makes all decisions. For the first model, the client needs profound knowledge about the solution space, whereas in the other model, the advisor needs substantial knowledge of the client's problem space (Gafni *et al.*, 1998). Neither model can be established in practice, as knowledge transfer in either direction is difficult. Transferring all relevant knowledge about the solution space, i.e. financial products, is considered unrealistic for practical settings due to the missing levels of expertise on client's side and the large amount of required information (Jungermann, 1999). The transfer of the client's personal situation, needs, and desires without showing the client concrete solutions options is also difficult (Novak, 2009), and is referred to as the "sticky information" problem (Von Hippel, 1994). Therefore, in practice there will be a mixture of informed decision-making and perfect agent models with missing information on both sides and practically reachable levels of completeness below the theoretical maximum. Of course, the goal is to minimize the amount of information lacking needed to foster informed decision. Based on the limited shared knowledge, we argue that, on the one hand, in traditional advisory settings a sufficient level of completion is mutually perceived, when the clients have told everything they considered to be important for an advisor to develop a purposeful solution. And on the other hand, this sufficient level of completion is also achieved when the advisors have asked everything they perceive relevant in order to give advice (and sell the appropriate products of course). Besides these situational levels of completeness, there also exist extrinsic motivations to gain information from the clients that go partially beyond the perceived needs of the participants within the service encounter. Normative regulations like the WpHG (German law on trading bonds) (WpHG, 2011) put banks under pressure to establish standards to ensure a minimum of information acquisition with the aim to protect the client from buying unsuited products. Moreover, additional information items gained during personal interactions can be beneficial to the financial institutions for profiling and cross-/up-selling opportunities (Tallon, 2010). During a traditional face-to-face interaction, these additional drivers for completeness can only be transported through the advisor, as the client is unaware of them.

2.4.2.3 Coercing into completeness in the presence of structures

Coercing into completeness is a phenomenon that can be analyzed in the context of the role of structures in the appropriation of technology. In his seminal "structuration theory", Giddens (1984) pointed out that structures may have unintended consequences and that it is necessary to understand the intentions of the creators and users of the structures to understand the effects of structures. Building on Giddens' work, DeSanctis and Poole (1994) developed the Adaptive Structuration Theory. Among other things, it stresses the importance of the "spirit" of an application and proposes different styles of appropriation ranging from direct use to direct negation.

There has been an intensive discourse on the role of structures in collaborative technologies. Researchers from the traditional CSCW disciplines (most prominently represented by Lucy Suchman in the famous dispute on the coordinator-mail system (Suchman, 1993)) tend to warn that pre-structuring sensitive processes such as communication or collaboration may conflict human cognition or established social norms. Researchers with a more business-oriented perspective (in the case of the coordinator dispute Terry Winograd (1993)) tend to stress the organizational benefits of prescribing structures ranging from less misunderstanding to higher productivity. There is even an emerging research stream on "collaboration engineering" (Briggs *et al.*, 2003; de Vreede & Briggs, 2005) coercing to prescribe structured collaboration routines to organizational users. While we see more failures than successes with rigid structures in the domain of collaborative technologies, the widespread adoption of ERP systems in organizations indicates that the organizational benefits of information systems can be so important that users adopt the system and the structured work practices even though many dislike them.

The conflict between organizational interests on the one hand and cognition and social norms on the other hand play an important role in pre-structuring financial advisory service encounters. Struggling with principal-agent conflicts (Eisenhardt, 1989; Novak, 2009), quality problems, and regulatory requirements (WpHG, 2011), banks push hard to establish structured advisory processes. In a straightforward implementation, they are interested in enforcing the process by the required use of a process-oriented software. Nussbaumer et al. (2012) have shown that an explicitly visible pre-defined structure of the advisory process (e.g. "information collection phase", "information phase", and "recommendation phase") will incentivize both the advisors and clients to follow this process. Nevertheless, all participants in such a highly structured process were dissatisfied with the whole service encounters because they felt part of a machinery (P. Nussbaumer *et al.*, 2012), and the interpersonal relationship-building between advisors and clients suffers (Heinrich, Kilic, Aschoff, *et al.*, 2014) in an unacceptable manner. Providing the process structure implicitly (hidden) instead of explicitly (visible), and thus leaving the process to the users instead of the information system, proved to be a superior solution (Nussbaumer, 2012; P. Nussbaumer *et al.*, 2012).

2.4.2.4 Designing IT artifacts to support implicit completeness

Supporting advisory encounters with appropriately designed IT-artifacts can be beneficial in many ways. Besides the obvious features of process documentation and integration of other information systems, they can also help to make the whole process more transparent to the clients (P. Nussbaumer *et al.*, 2012) through the use of shared artifacts between client and advisor (Novak, 2009). But with respect to the information collection phase, IT-artifacts can be used as a way to commonly objectify (Heinrich, Kilic, Aschoff, *et al.*, 2014; Weber, 2000) the discussed information items.
IT-artifacts have to be designed carefully so that they do not interfere with the fragile social setting, which is given in any dyadic service encounter. As stated before, it has been demonstrated that enforced process guidance has strong negative effects on the acceptance of such solutions (Nussbaumer & Matter, 2011). However, visualizations and interaction models without fixed structures like "loose widgets" and the "zoom and filter" metaphor have been evaluated to be far more successful than "PowerPoint-like" step-by-step metaphors of process guidance (P. Nussbaumer *et al.*, 2012). Such

representations deliberately omit a notion of beginning, completion, or progress of the current task or process. Hence, negotiating on completeness should still happen between the participants as within traditional pen and paper-based encounters.
This stream of research leaves open the following issue: Why did the advisor and the client in our setting strive for completeness, although the software did not explicitly visualize or enforce it?

2.4.3 Research Framework

The methodology used for the research project can be conceptualized as exploratory research (Briggs & Schwabe, 2011), emerging from design science research (Hevner *et al.*, 2004) (DSR) activities. Thus, this paper generally follows a structure typical for DSR-related publications (Gregor & Hevner, 2013) and describes all of the six typical DSR activities (Peffers *et al.*, 2006): *(1) problem identification, (2) objectives of a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication*. The introduction covers (1) and (2), whereas the artifact description covers (3) and (4). However, the paper focuses especially on the evaluation (5). In contrast to "confirmatory research" (Briggs & Schwabe, 2011), where the fulfillment of the solution objectives is demonstrated, we use the evaluation as a vehicle to explore why the observed phenomenon emerged and how it manifested itself. Therefore, this paper has an in-depth results and discussion section, where we reason about the factors that lead to coercing into completeness. The last activity (6) — namely, the communication of the results — is the purpose of this paper.

According to Briggs et al. (2011), the core contribution of exploratory design research is the description of new phenomena and/or its emergence in new contexts. In this paper, we identify and describe the "phenomenon of coercing into completeness" in the context of dyadic advisory service encounters, in which it occurred and started the discussion on possible explanations and factors that lead to the occurrence of this phenomenon.

2.4.4 Initial implementation of the artifact

Following the DSR methodology (Peffers *et al.*, 2007), we have specified, designed, implemented, and evaluated an IT-prototype. In that research project, we worked in close cooperation with a major Swiss retail bank.

The *main design rationale* was to support advisors and clients during the needs elicitation process. Therefore, we intended to support the collaboration with technology to enhance the understanding of the client's situation. Together, advisors and clients should create a "picture" of the client's situation and needs. The advisor should have a means to externalize, organize, and discuss the client's information and to summarize the client's themes using this picture. The client should observe that the data was collected transparently and have the opportunity to make immediate corrections, if necessary. In consequence, the advisors' understanding of the clients' situation should be externalized and be verifiable for the client. Furthermore, to overcome the sticky information needs problem, the client should be stimulated to talk about additional topics, which were visualized on the display serving as prompts but not asking for information directly. From an organizational point of view, the bank is interested in collecting information in a holistic manner and to analyze this data. The bank wants to know its clients to unhide up- or cross-selling potentials and use them for marketing actions. Therefore, the data should be structured and digitalized. If this data is seized electronically, it is possible to transfer it into a customer relationship management (CRM) system for further analysis.

To guide the design of our artifact, we choose the metaphor of a mind-map to support the information collection phase, as it fulfills the aforementioned demands of providing a flexible and adaptive content structure. Computer supported mind-maps have been shown to be applicable in collaborative settings and have also proven to be beneficial to collaboration in terms of leveling the amount of contribution between the collaborating participants (Buisine *et al.*, 2007).

2.4.4.1 Artifact design

The IT-prototype ("Needs Map") was designed with a mind-map analogy displaying the text "me" and the name of the client in the middle and six connected branches as a start: work, residence, family, leisure, finance, and assistance. Stimulating information items, which could be attached to the existing structure, were displayed adaptively with respect to the currently selected item within a large list on the sidebar: selecting one item within the map showed information items related to this branch on the right sidebar. For example, by selecting the branch "work" the items "job", "part time job", "study", and "career" were shown (see Figure 23).

There are three kinds of information items available: information regarding the current situation (such as the current job), concrete goals (such as buying a car), and wishes (for example, goals in future such as buying a family home). The interaction to assign an information item to a branch or another item is realized by dragging and dropping an item on the touchscreen from the right side near to the selected branch or item. There was no limit on the amount and level of items, which could be attached to a branch or another item. It is also possible to add one-time or monthly income and expense information to every information item. The six initial branches (see Figure 23) provided an opportunity to structure the discussed information. The additional information items were provided to stimulate the participants during the needs elicitation phase.

It was intended that clients tell about their current situation, needs, and goals, and that the advisors organize this information in the map in an appropriate branch. We also expected that advisors would use the inherent features of a mind-map, especially the possibility to extend the given structure according to the conversation. In doing so, the client has the opportunity to see transparently how the information is recorded and to correct wrong information.

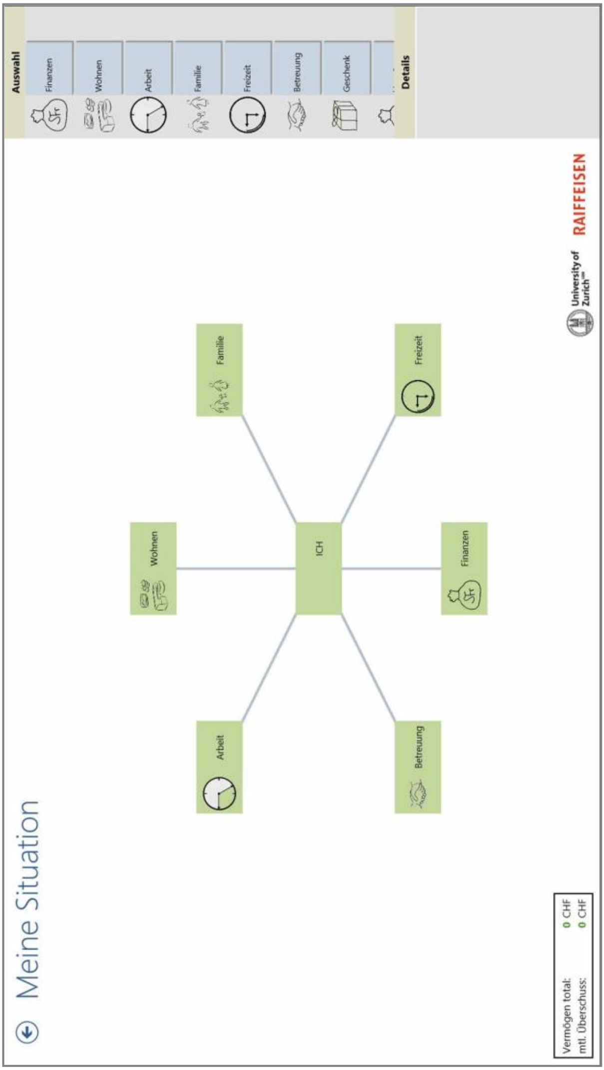

Figure 23: Start screen with empty mind-map. Translation from German:
Meine Situation – my situation, Arbeit – work, Wohnen – residence, Familie – family, Freizeit – leisure, Finanzen – finance, Betreuung – assistanceEvaluation

2.4.5 Data collection

The evaluation of the IT-prototype was accomplished with 16 experienced financial advisors and 48 potential clients (bachelor students from a business informatics course) in a realistic setting. During the advisory service encounter, the participants worked with our IT-prototype. The software was executed on a tabletop computer (a 27-inch touchscreen). The physical environment was designed to enable both participants to interact with the system. The evaluation was conducted as a within-subject design. Thus, every client took part in two advisory service encounter treatments: one traditional pen and paper encounter and one supported by the IT-artifact. The evaluation was carried out over eight days. On every day, two advisors were present onsite and each of them conducted six advisory sessions (three traditional, three IT-supported). Preceding the evaluation, the advisors were first trained one week prior through video explanations and written training material. On the day of the evaluation, each advisor received 60 minutes of personal hands-on training with the artifact.

After the clients had received their two treatments, they were interviewed. Advisors were interviewed at the end of each test day. The interviews were conducted in the form of a semi-structured interview of approximately 30 minutes duration for the clients and approximately 45 minutes for the advisors on average. Video-recordings were taken of the encounters. Screencasts were also recorded for the IT-artifact supported encounters.

2.4.6 Results

To broadly elicit data about the phenomenon, we studied the resulting mind-maps from the sessions, the conversations, and interactions between clients and advisors and how the participants perceived the encounter. The mind-maps were extracted from the screencasts, the conversations were analyzed through the video recordings, and the perceptions of the participants were mainly extracted from the interview data as well as from comments made during the video-recordings. Within each following section, we briefly describe how the data sources were analyzed before presenting the results.

2.4.6.1 Manifestation of coercing into completeness in the resulting mind-maps

We assessed the result of the mind-maps by capturing the state of the map after the last interaction with it.

In almost all advisory sessions the participants filled out at least five of the provided six branches with personal information of the client (see Figure 24 and Figure 25). Additionally, in most sessions they also talked about the branches that were not filled, but there was either no information to fill out or they decided to leave the branches empty. For example, when the clients were not married or in a partnership they decided not to record this in the family branch (see Figure 25). One advisor of 16 did not really use the mind-map; she filled only the “finance” branch with minimal information.

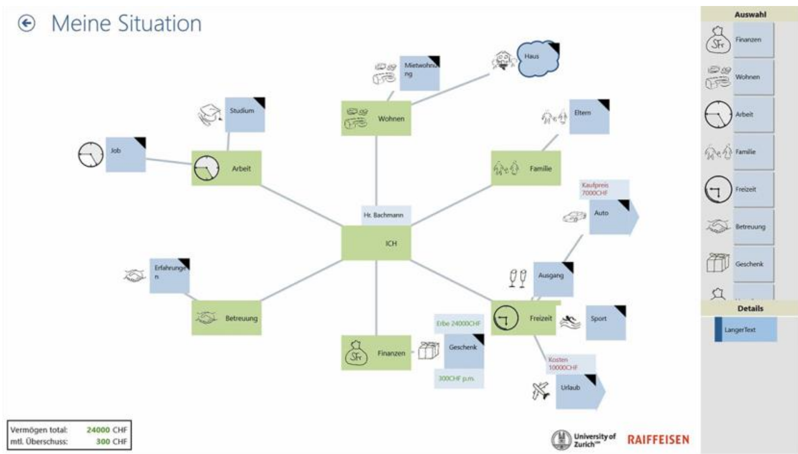

Figure 24: Example of completely filled mind-map

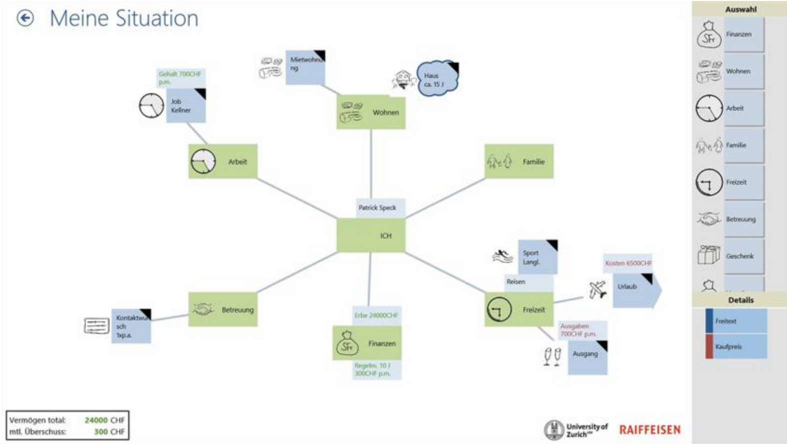

Figure 25: Example of mind-map with empty family branch.

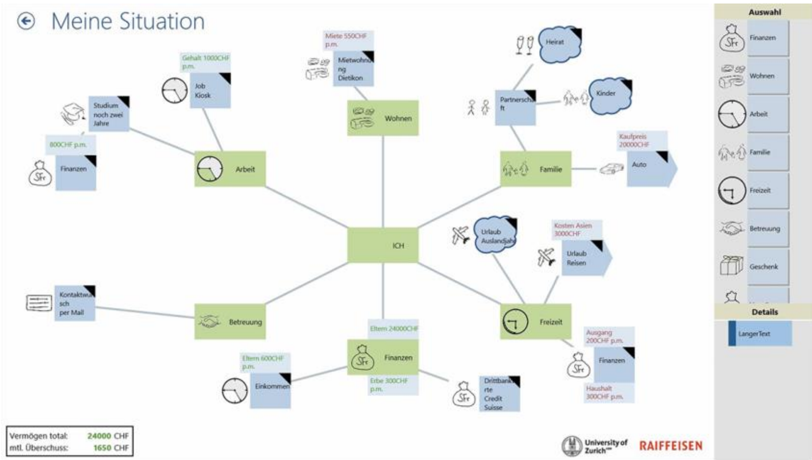

Figure 26: Example of filled mind-map with two levels.

Examples of resulting mind-maps are shown in Figure 24, Figure 25, and Figure 26. Figure 24 shows a mind-map where at least one information item is attached to a branch, so they have talked about the topic of each branch and recorded the corresponding information. In Figure 25, a mind-map is shown where the family branch is left empty. The mind-maps were mostly filled out in a broad and rather superficial manner. The participants only used one level of depth. From all 48 advisory sessions, only in one session did the participants create items on the second level (see Figure 26). In the remaining 47 sessions the information items were directly attached to a branch.

2.4.6.2 Manifestation of coercing into completeness in the conversation

By analyzing the screencast alongside the video recordings, we can assess the structure and flow of conversation. In this section, we present a two-step approach analyzing the structure of the conversation. (1) We analyze in which order the topics were discussed within the IT-supported setting. (2) Then, we analyze the transitions between the discussed topics to shed light on the question of how the presence of the artifact changed the discussion behavior of the participants.

In the first step, we analyzed 16 video-recorded sessions and traced the sequence of the discussion topics (see Table 5). For this analysis, we included each advisor's last IT-supported session in the sample. We argue that in the last session the advisors showed the most proficient use of the IT-artifact and were well accustomed to the setting.

Seven advisors start with the branch "work" and talk about the topics in a clockwise direction. Four advisors start with another branch (2 x finance, 1 x residence, and 1 x leisure), go to "work", and then go further in a clockwise direction. In summary, 11 advisors start with "work" as the first or second topic and then follow a clockwise structure. When all paths are visualized together, (Figure 27) a pattern emerges and reveals that most advisors follow an identical path. Four advisors do not follow an identifiable pattern. One advisor does not make use of the mind-map at all. Those five were omitted in the visualization for clarity.

In the second step, we took another sample. As we assume that the conversation behavior is strongly related to the individual advisor's personality, we only select advisors with comparable customer satisfaction ratings in the traditional encounter. We analyzed the pairwise recordings from 8 advisors and 8 clients, including 8 traditional encounters and 8 IT-supported ones. Thus, there were 16 sessions in total.

An analysis of how many conversation sequences are present within the information collection phase reveals that significantly more sequences are present within the IT-supported encounter compared to the traditional one. For the analysis, we have transcribed the participant's utterances and identified conversation sequences. One conversation sequence is characterized by the amount of adjacency pairs, i.e. pairs where the question of the advisor is related to the ongoing discussion or answer of the client. Every time the advisor asks a question not related to the ongoing discussion, a new sequence starts.

In the IT-supported encounter the conversations consisted on average of 7.9 (sd=2.17) sequences, while the traditional ones only had 4.5 (sd=2.07) sequences. A two-sided paired-sample T-test reveals this difference to be significant ($T(7)=4.473$, $p<=0.005$). However, the numerous sequences of IT-supported encounters seem to be shorter.

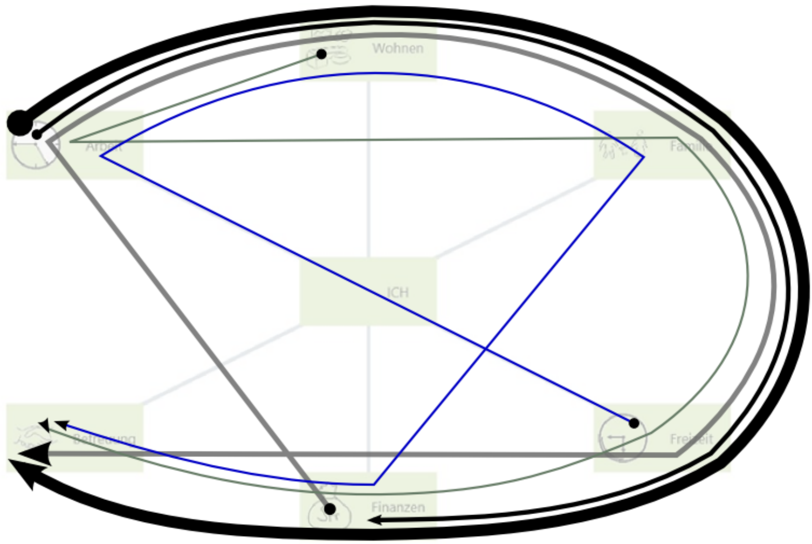

Figure 27: Visualized path of 11 clockwise conversation patterns. Thick lines visualize several occurrences of the same path. Patterns from the other 5 advisors were omitted.

The length of the sequences is determined by the number of continuous turn-takings while relating to the previous given answers. A sequence ends when the advisor switches to another topic without relating it to the previous content. An example could be an ongoing discussion about the employment situation terminated by the advisor by asking the client to provide details on his leisure time. Figure 28 shows that in IT-supported encounters more than half of the sequences are only of length one or two. This means that those sequences consist of a single question-answer pair with or without a following single turn-taking of asking and answering details.

Table 5: Summary of the topic order discussed in the last IT-session of each advisor.

	Work	Reside	Family	Leisure	Finance	Assistance
Adivsor01	1.N	2.N	3.D	4.N	5.N	6.N
Advisor02	1.N	2.N	3.D	4.N	5.N	6.D
Advisor03	4.N	1.N	2.A	3.N	5.N	-
Advisor04	3.N	4.N	5.N	2.N	1.N	-
Advisor05	2.N	3.N	4.N	5.N	1.N	6.N
Advisor06	2.N	1.N	3.N	4.D	5.N	6.N
Advisor07	1.N	2.N	3.N	4.N	5.N	6.N
Advisor08	2.N	3.N	-	4.N	1.N	5.N
Advisor09	3.D	2.D	-	4.A	1.N	5.N
Advisor10	1.N	2.N	3.D	4.N	5.N	6.N
Advisor11	1.N	2.N	3.D	4.A	5.N	6.D
Advisor12	1.N	2.N	3.A	4.N	5.N	-
Advisor13	4.N	1.N	2.N	3.N	5.N	6.N
Advisor14	1.N	2.N	3.N	4.N	5.N	-
Advisor15	3.N	2.N	6.D	1.N	4.N	5.N
Advisor16	2.N	3.N	4.N	1.N	5.N	6.N

N: discussed and noted information in the mind-map,
D: discussed information but not noted in the mind-map,
A: asked about, but no information provided, - : not discussed at all.
The numbers represent the sequential order of occurrence in the conversation.

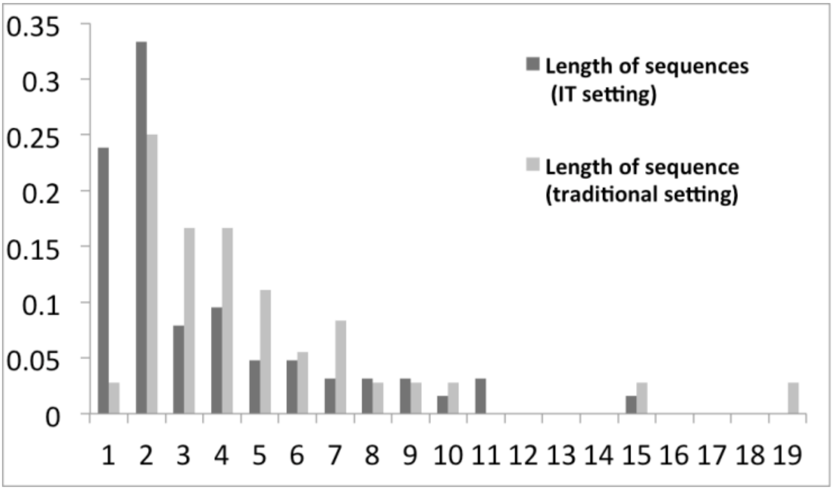

Figure 28: Relative distribution of length of conversation sequences (histogram) for traditional and IT-supported service encounter

In traditional encounters, however, the sequences tend to be longer. It has to be noted that one advisor had a completely different conversation style than the other 7 advisors that we analyzed. This particular advisor used pen and paper together with the IT-system. When discussing a topic, he made short notes on paper, and after a sequence was finished, he entered the data into the IT-system. This resulted in a conversation comparable to a traditional one with only 5 sequences of which two of them were exceptionally long, containing 10 and 15 turns. Removing this case from the sample, a Related Sample Wilcoxon Signed Rank Test supports the impression of the samples being longer within traditional encounter settings ($p<=0.05$) in pairwise comparison.

Regarding the discussion strategy within the IT setting, two groups of advisors are identifiable. The main difference between these groups is the appropriation of the mind-map to guide the conversation and the usage of the wording from the mind-map. Many conversation sequences begin with an explication of an inferred process in the IT setting. Typical statements at the beginning are “Then, we go to the next topic which is family” or “Next to residence”. Analyzing the last sample, more than 39% of all sequences were motivated like that. Of those sequences, more than 77% had only one or two adjacent pairs (question-answer pairs) (cf. Figure 28) — a style we barely observed in traditional settings.

The other sequences resemble discussions with the client about his situation without any observable influence originating from the mind-map’s structure. Parallel to the conversation, they fill out the provided information in the mind-map. This group asks more open questions like “Where do you live?” instead of “Let's go to the topic of residence”, or “Have you already had experience with investments?” instead of “The last topic is assistance”.

In some sessions, even clients expressed an adaption of a process structure. An exemplary statement is “*Should I begin with work?*” while pointing onto the touchscreen. Another participant asked, “*Should I follow the pattern?*” (while gesturing a path around the map). In some cases the clients pointed out that they, for example, have not yet talked about the family situation. When recognizing other information items relevant in their situation (like part time job, travel, or marriage), some of the clients mention them without being asked, such as having a plan to marry.

2.4.6.3 Manifestation of coercing into completeness in interviews

We have transcribed the audio-recorded interviews and analyzed them to find statements from advisors and clients regarding the phenomenon of coercing into completeness. Almost every advisor (13 of 16) reports on a strict process or a perceived obligation to fill out the mind-map completely or at least to talk about every topic. One advisor says, “*For most young advisors it could be a benefit having to talk about all topics that would otherwise not be addressed*”. Another advisor declared, “*For me it is too rigid; everything is predetermined*”. A third advisor talks about a “*given schema*” which guides the conversation. Yet another advisor compares the mind-map with a checklist: "*With a checklist you ask the client how much he earns, you fill it out, and it is done. The mind-map has the same principle. You go through every branch, starting with one than the other. You are filling out each of them*". One more statement supports this felt obligation: "*You know exactly that you have to go through family and everything*". One advisor also had the perception that he can follow the given process without having to think about it: "*You do not have to think; everything is given*". These statements show a strong perceived obligation to talk about every provided branch and the cognition of the mind-map as a checklist.

Besides some advisors, a substantial number of clients (15 of 48) also report in the interviews to have negative opinions concerning the mind-map design and stated that they would still prefer a traditional setting. Some statements from the clients are "*The traditional advisory was more personal, maybe because the process was not so obvious*", and "*You go structurally through everything*". Thus, some clients have the feeling of only filling out something without understanding why this should be necessary: "*You only have to fill out something in a tool*", "*it was just a matter of filling out numbers and list the expenses*", and "*With the IT tool, some information was gathered that was not necessary. Not all of those questions were necessary to get to know each other*". One client expresses that he has the feeling of being restricted while acting with the mind-map and that "one is restricted to the topics on the mind-map".

2.4.6.4 Reasons for coercing into completeness in interviews

In our interviews, we have identified statements from advisors which partly explain the phenomenon of coercing into completeness.

First, advisors do not want to **forget to ask something important**. Some advisors say that with the tool they ask for information that they otherwise would forget to ask. For example: "*There are certainly three or four things I usually do not think about. I have been reminded*". Another advisor reports that he is filling out everything because it reduces the risks of forgetting something:

"*You can fill out everything. What is in it is there. Then you cannot forget it*". Interestingly, in the traditional advisory sessions the advisors do not act in the same manner. In the conventional, pen and paper-based session, it seems to be acceptable for the advisor not to ask for information, but in the IT-supported session they do not want to forget something, and therefore fill out the mind-map in a perfect manner.

Secondly, advisors report that it is **much easier to retrieve information** from the client. They report from reduced obstacles in the IT-supported setting: "*The IT-tool is helpful to talk about certain topics and to analyze the situation without hesitation*", and, "*One dares to ask more directly to get an answer. In the traditional setting you are quicker satisfied if someone is shirking away. With IT I have to fill it out*". Another advisor points out that the clients are willing to tell more in the IT-supported sessions: "*The client is talking quicker about his family and leisure activities. I think he is more open because he sees: 'I also have to complete this field'*". One more statement regarding this aspect was mentioned: "*I consider that one is asking the client with the IT-solution more precisely; you are expecting much more detailed answers*".

The third reason, which we identified, is that many advisors have the perception that the **client is expecting** the advisor to talk about the topics: "*It is not acceptable that I do not talk about some topics. I think this would be strange for the client*". Other advisors identify the visual aspect of the mind-map as a reason for the perceived client expectation: "*The client is seeing all topics of the mind-map and comments them on its own*", and, "*Because the field is represented there. The client said on its own that we still have to talk about the topic of family*". Another statement, which stresses this perception, is the following: "*If family is shown there, the client is asking himself: why does he not talk about this?*" Moreover, the statement "*The client can estimate what is expected of him*" also hints into this direction for interpretation.

Fourth, one advisor has the perception of **being monitored** by the bank: "*My supervisor would ask, 'Why have you not talked about his topic?' So it is possible to monitor me and see the missing topics*".

2.4.7 Discussion

Based on the rich data we gathered from the video analysis, interview statements, and observations presented in the results section, we make conjectures on the mechanisms that lead to the "coercing into completeness" phenomenon. By discussing the relevant findings and relating them to the existing literature, we aim to answer our two research questions: (1.) how the service encounter was affected through the phenomenon and (2.) why the phenomenon could still occur although the problem of rigid process visualization and enforcement is known in literature and was deliberately avoided in artifact construction. Finding explanations for this phenomenon is important, because IT-supported service encounters as such can bring great benefits to all stakeholders but must not interfere with the social setting at the same time, thereby deteriorating the otherwise successful collaboration. Financial advisory services need to be flexible to the clients' situation and their desires and goals.

According to our data, advisors liked our artifact and most of them appreciated the guidance from the system. However, a substantial amount of our clients still preferred the traditional setting and were concerned about the way their information was collected. Many of them stated that they perceived several discussed information items as unnecessary for the ongoing service. In general, we could not demonstrate in our data that the information provided by the client was any different between those settings. However, the way that information was retrieved turned out to be substantially different: While in the traditional settings we generally see a small number of long conversation sequences (where any further question to the advisor is highly related to the previous discussion within those sequences), in the IT-supported counterpart the conversation is much more fragmented. This style of conversation is characterized by a large number of very short question-answer pairs. As those sequences are not well related to each other, this style of conversation resembles the discourse structure based upon a structured questionnaire. As the artifact does not enforce (or even visualize) any representation of a process but the IT-supported conversation is heavily related to the content presented within the tool, our main conjecture is that those content structures are the cause of the observed phenomenon.

2.4.7.1 Content structures coerce for completeness.

Traditional service encounters are typically executed in an isolated environment. Only the client and the advisor are present. The information and topics that were discussed stay private, except for a written documentation of the advisory encounter prepared by the advisor afterwards, which is filed in the bank's CRM system. Therefore, the quality of the service encounter itself can only be directly controlled through the participants. However, we generally assume that the client only has a vague and limited idea of what a good advisory service should consist of. Thus, the appraisal of the service quality strongly relies on the role of the advisor and his skills.

When technology is introduced in such service encounters, different mechanisms may emerge. With our IT-artifact of an advisory support system we did not only support the activities of clients and advisors but also injected a content structure into the setting. Initially, we intended this structure to serve as a help to organize the objectified topics of a discussion. But actually, we thereby unintentionally fostered a coercing into completeness as expressed by the interview statements from the participants: Both clients and advisors inferred a notion of completeness from that given structure and even more worrying a notion of service quality. Some clients and advisors seemed to agree that a good service needs to cover all items from the given structure. We attribute this to the perception that the advisory service is no longer delivered in a private dyadic setting but is rather directly connected with the institutional quality standards through the IT-artifact. And since the design of the artifact is also influenced by the institution, its norms and values ("spirit" of the design) are embedded within the artifact itself. Hence, we can understand the perception that any given element within a structure is included for a reason and — being visible to the client and advisor simultaneously — might be perceived as equally stimulating and important. We found at least two driving forces within the interviews and observations that help to explain the phenomenon of coercing into completeness from this perspective, which we will present in the following sections.

First of all, in the IT-supported sessions, some advisors had the perception that it is easier for the bank to control if they are doing their jobs correctly. One advisor explicitly feared that her performance could be measured along the structure by their principals later on; she feared that she might need to explain why she omitted to discuss some items on the structure. From a client perspective it also seems unreasonable to omit items in a given structure. As we could observe during the evaluation, some clients explicitly asked the advisor why an object was omitted and demanded an explanation for what it was intended for. Thus, both participants seem to treat the given content structure as the gold-standard for quality. We call this the **"invisible third participant"**, who influences the course of the advisory service through the spirit embedded in the artifact and provokes the phenomenon of coercing into completeness.

2.4.7.2 Content structures promote a process to reach "completeness"

In traditional financial service encounters, the order of the topics to be discussed is highly individual and dynamic. None of the participants can prepare a definitive script as the course of the discussion emerges on-the-go, driven by events (like one party mentioning an interesting aspect) that sparks the motivation to follow this topic in the succeeding discussion. It remains a challenge and is the responsibility of the advisor to keep the discussion coherent and logically structured.

Content structures that manifest through the artifact seem to be willingly adapted by the advisors to implicitly guide the whole process and help them to retain a common thread. In our experiments, there were statements from the advisors directed to the clients that clearly back up this claim. We observed that the majority of the advisors, guided by the mind-map, followed the given structure item-by-item, and they even verbally marked the switch from one item to another. Thus, the process is not event-driven anymore and does not adapt to verbal statements made by the client. Therefore the process is much more fixed. An unhindered flow with natural conversational sequences - where given answers spark new questions - is hardly noticeable. With the tool we see processes where advisors ask the clients to tell them all relevant issues to a specific topic before switching abruptly to the next one. This “game” ends when there are no more items that need to be covered. Again, we attribute this observation to the dyad’s participant’s striving for completeness, albeit they bear different motivations.

Even worse, the mind-map's default structure with the six branches could be interpreted as a progress indicator with six sub-tasks. Like other progress indicators, a minimum and maximum (”no topics discussed” and “all topics discussed”) are visualized at any time during the interaction, and therefore implicitly provide a notion of completeness and progress although never intended as such. Filling out nothing and leaving the map empty explicates the minimum state. Discussing about one branch or filling it out brings the participants one step further to task completion. Just talking about the topic of a branch or even filling it out with at least one information-item contributes to the participant’s perception that this sub-task has been finished. It has to be noted that the discussion is far richer than the information entered into the system. However, this might also be solely explainable by the effort of entering data into the system and potential usability problems. As discussed in the related work section, progress indicators can have a positive influence on the motivation to complete tasks in a single user context. But in dyadic settings, this effect can negatively influence the collaboration. As previous design activities (P. Nussbaumer *et al.*, 2012; Nussbaumer & Matter, 2011) have demonstrated, the negative effect of explicit process representation (visible) can be dampened by implicit representations (hidden). However, the given content structure in our design led our participants to develop an unintended perception of having a process indicator visualized. The appropriation of this content structure as a process indicator representation can be explained by the adaptive structuration theory (DeSanctis & Poole, 1994). This effect was certainly not intended during the artifact's construction. We call this driving force **"parasitic process and progress visualization"**.

2.4.7.3 Content structures fixate the level of details

In traditional financial service encounters, the level of detail on which items are discussed and written down on paper is based on a subjective perception of their relevance. Topics that are perceived more relevant than others are covered in greater levels of detail. A notion of completion is either implied by the perceived level of saturation on a given topic or the discussion is deliberately aborted due to time constraints.

Given the driving forces of the "invisible third participant" and the "parasitic process and progress visualization", a pattern emerges which causes concerns: Instead of adapting the level of detail to the relevance of the topics, we observed a uniformly low level of detail for all topics discussed. Referring to the related work, the information items are considered "sticky" (Von Hippel, 1994) and thus hard to express for the client. It was our intention to facilitate the process of their explication by providing graphical stimulating icons in order to unhide and identify this sticky information. This should have been also happening by refining the map's content incrementally. But instead, most advisors added to each category only one or two items without adding more levels of hierarchy to the map.

In the light of a realistic model of financial advice giving and taking (Jungermann, 1999), this practice can be judged twofold: (a) it could serve as a help for unskilled advisors reminding them to elicit and capture the most basic information items; (b) but it constitute at the same time a threat to the performance of skilled advisors because they might be able to capture more information items within a convenient conversation in the traditional pen and paper setting and subsequent manual written documentation.

Judging on the low levels of actual information content recorded within the mind-map, we also assume that the average advisor performance with respect to captured information quality might be lesser compared to the traditional encounters and their subsequent manual documentation. However, this is subject to further research, as we do not have sufficient data from this evaluation. We call this **"dilution"**.

2.4.8 Conclusion

In this article, we report on the phenomenon of coercing into completeness. The phenomenon emerged in the context of IT-supported financial service encounters. A carefully designed IT-artifact could successfully support the first phase of financial service encounters (information collection phase) but negatively influenced the participant's collaboration as they tended to strive for reaching completeness. We identified content structure as the cause for the observed three effects. This conclusion is also based on the results of our evaluation and the literature. In collaborative situations, content structures can induce severe and unintended effects, such as (a) the identified invisible third participant, (b) the parasitic process and progress visualization, and (c) possibly lead to a decrease in information quality. Therefore, a central design implication for future systems is that any form of predefined structures has the potential to be interpreted as rigid process structures. Thus, care has to be taken when presenting predefined content structures within those artifacts. This finding extends the current research, as non-sequential process visualizations have been thought to be unproblematic within those settings in general. Nevertheless, we could demonstrate one case where this conjecture does not hold. Even worse, a hierarchical structure, which never was intended as a process representation has been perceived as such. Through this evaluation, we have also shown how difficult it can be to construct non-trivial artifacts while maintaining the quality of collaboration in socially sensitive settings.

We also respect the necessity to provide structures in some way within the artifact to enhance transparency and thus diminish information asymmetry and the principal-agent conflict (P. Nussbaumer *et al.*, 2012). We conclude that there will be a tradeoff in the design between the provision of structures for desired outcomes and the endangerment of social interactions. When predefined structures cannot be avoided, proper and special training of the advisors seems to be crucial for dealing with these problems on an organizational level. We assume this because we observed a few advisors neglecting the structure as guidance completely and using their usual discourse practices from traditional pen and paper encounters. They interpreted the spirit in another way and used the structure only to fill in the gathered information like using a notebook. Also, due to the fact that none of the advisors recognized this disruptive style of conversation by themselves, we do not assume that the problem vanishes by itself solely due to rising work experience with the artifact.

We assume our findings are generalizable to other advisory service encounters as well (like physicians, assurances, travel agencies, etc.) whenever technological artifacts are to be designed. With our contributions, we extend the current state of knowledge on how design aspects of such artifacts and how those artifacts can influence the behavior of the encounter's participants. More specifically, we shed light on the harmful role of content structuring in advisory encounters.

2.4.9 Limitations

The external validity of this research is limited by the fact that the evaluation was carried out in a laboratory setting. Apart from that, the evaluation was carried out realistically with real and experienced advisors and potential customers. Also, during the design of the artifact the management of the bank was involved. Statements from the advisors suggest that they behaved as if they were still in their organizational context. Although it was an experiment, the setting was close to reality. We are aware of the fact that the clients from this experimental evaluation were undergraduate students, and thus a relatively homogenous group compared to average bank clients. For example, in this group it is unlikely that clients have children, but the advisor still felt obligated to cover this topic. Due to the experimental environment one could argue that the advisors might have felt to be urged to use the artifact completely. However, this seems unlikely, as the advisors provided numerous reasons why they coerced for completeness but no single one attributed it to the experimental setting.

2.5 Communicating nascent design theories on innovative information systems through multi-grounded design principles

(CONFERENCE PAPER)

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Abstract. One central goal of design science research (DSR) is to generate, extract and communicate knowledge about the design of an artifact. Design science researchers ultimately strive to contribute knowledge in the form of mature design theories; mere descriptions of the artifacts are not regarded as sufficient contribu-tions to knowledge anymore in scholarly publications. There is an increasing body of guidelines on how to produce and publish mature design theories. However, not every research project is in that state. To publish intermediate results (i.e. nascent theories), only general, abstract publication schemes can be found in the recent literature making it difficult to publish design knowledge at that intermediate level. In this paper, we contribute an extension of an existing publication scheme, tailored towards the publication of such intermediate, work in progress design knowledge in the form of prescriptive design principles. This scheme was designed with

respect to the complexity of today's information systems IT artifacts. To demonstrate the scheme's applicability, we will apply it to one of our re-cent scholarly publications in the CSCW area. We argue that this publication scheme extension will help to communicate design knowledge in earlier project stages, which allows a faster feedback to the knowledge base that will enable a broader community to participate in the "search process" for an optimal design solution.

Keywords. Design science research publications, design principles, design theory

2.5.1 Introduction

Design oriented research is well established in IS research, particularly in Europe (Winter, 2008). There is a vast body of literature that generally describes DSR in theory as well as in practice (i.e. Hevner *et al.*, 2004; Hevner, 2007; Peffers *et al.*, 2007; Reinecke & Bernstein, 2013). There is general consensus that design science focuses on the acquisition of new knowledge through the design and evaluation of artifacts. "The fundamental principle of design science research is that knowledge and understanding of a design problem and its solution are acquired in the building and application of an artifact."(Hevner & Chatterjee, 2010). But when it comes to practical research projects, the definition of what design science exactly is, starts to blur. The existing publication guidelines aim to be applicable for a wide variety of fields, methods and artifacts and therefore lack specificity required to stringently describe practical projects in specific fields. Baskerville (2008) highlighted the current ambiguities and misunderstandings by filling most of the space in an editorial describing what design science is not (Baskerville, 2008) and he is using one paragraph to advise the reader to make up their own minds by treating the DSR related articles in that journal issue as "best examples". Moreover, Gregor et al. (2013) conclude that there is still a lack of clear understanding what defines a contribution to knowledge in the publications from DSR projects. To address the aforementioned problem, Gregor et al.'s article (2013) provides a detailed framework for knowledge contributions and a schema for publishing DSR projects but in the end stays on an abstract level in order to be applicable to all kinds of practical DSR work.

For more mature knowledge however, i.e. design theories, there are several guidelines available (Jones & Gregor, 2007; Gregor, 2006) on how to publish them, but not every research project is in that mature state. But as design science is regarded as an ongoing "search process" (Hevner *et al.*, 2004), it is from our point of view vital that design knowledge is contributed to the community especially in early stages. Otherwise the search process would be carried out by individuals rather than within a larger community.

Therefore, this paper aims to close that gap by extending Gregor et al. (2013) in order to give specific guidance on the description of the artifacts and their design rationales with a focus on innovative information systems. Thus, the over all objective for that schema extension is to *foster the publication of nascent design knowledge in scholarly publications*. (In DSR terminology, this could also be called solution objective for the artifact, as discussed later in this article.)

This is a rather practical goal. However, by working on an artifact to reach this goal we can also contribute to the scientific knowledge base of DSR with its stream of literature on the publication of DSR results. The research question therefore addresses a gap in the current body of literature:

Research Question: *How can early design knowledge on information systems artifacts be rigorously communicated through nascent design theories at any time in the research process?*

To motivate the need for an extended DSR publication schema we report shortly on our experiences in communicating DSR. The past DSR activities in our research group often targeted the design of innovative IT artifacts in collaborative work environments like advisory service encounters. Although we (and our research group) published DSR related articles in the past years in the domain of travel agencies (Novak & Schwabe, 2009; Schmidt-Rauch & Schwabe, 2011) and the financial industry (P. Nussbaumer *et al.*, 2012; M. P. Nussbaumer *et al.*, 2012; Heinrich, Kilic, Aschoff, *et al.*, 2014), we often faced a number of problems during the writing process, which sometimes even hindered the publication of valuable design knowledge. (1) During the course of such a projects, design knowledge exists at various levels of maturity at any given point in time (i.e. the time of writing). When publishing results from DSR activities we were often obliged to communicate knowledge with different levels of maturity simultaneously in order to describe our artifact and its design rationales stringently. However, we found it challenging to mix those levels of maturity while demonstrating overall rigor in a publication. (2) As the design space of possible artifacts is very large, it is in general impossible to address all design decisions in one single publication. Thus a selection of design aspects targeting the specified design goals have to be made and communicated transparently in order to avoid an impression of a random selection to readers. (3) As DSR activities are typically performed in a cyclic sequences (Hevner, 2007) knowledge materializes at different stages in the process. This often does not seem to fit well into generic and linear structure of DSR publication schemas.

To address those problems, we will discuss the current literature on publishing DSR contributions to knowledge with a focus on designing and implementing IT-artifacts in real world contexts. We contextualize the current literature and existing publication schemes with our observed practical publication challenges and identify existing gaps.

We then review the related literature and identify the necessary components and constructs to base the proposed framework upon. The main contribution of this article is the extended publication schema based on Gregor et al. (2013) and a demonstration of its application to one of our previous research projects.

The paper ends with a discussion of the proposed schema and its value to future research.

2.5.2 Related Work

The discussion of how to publish design knowledge already started decades ago. Walls et al. (1992) provided a first structure for design theories. Walls et al.'s design theories were structured around 4 major components: "meta-requirements", "meta-design", "kernel theories", and "testable design hypothesis". The first component "meta-requirements" covers the description of the system objectives. The word "meta" was used to distinguish the project specific requirements from the more generic or abstract requirements covering the class of problems a design theory addresses (Walls *et al.*, 1992). The second component, the "meta-design", deals with describing the design abstractions, describing the essential rationales of the design solution. Again, the "meta"-prefix distinguishes the concrete artifact instantiation form its more generic or abstract counterpart in the design theory, that addresses a whole class of systems (Walls *et al.*, 1992). The third component, "kernel-theories" are meant to include justificatory knowledge for the developed theories. The fourth and last component, "testable design hypothesis", is used to provide evaluation criteria for the meta-design with respect to the meta-requirements (Walls *et al.*, 1992).

Gregor et al. (2013), also incorporating the work of Walls et al., developed a much more practical and recent framework for presenting design science research. This general framework provides a structure for complete DSR articles and includes the sections *introduction, background, method, artifact description, evaluation, discussion and conclusion*. For each section, the authors prescribe the nature of the expected content. However, as the article strives to addresses all possible kinds DSR projects, the descriptions are on an abstract and generic level. While most of the framework's sections may be directly applicable in many practical research projects, at least two of them are currently too general to be directly applicable. One of them is the "description of the artifact". In this section, the authors are required to give a "[…] concise description of the artifact at the appropriate level of abstraction […]" (Gregor & Hevner, 2013). But no guidance is given on how to describe the design of a complex information system. The other too generic section is the discussion section, where in the case of complex socio-technical systems an "[…] explicit extraction of design principles may be needed" (Gregor & Hevner, 2013). There, too, no guidance is given on how to publish information in a rigorous way. Arguably, both sections might be the most important ones when it comes to demonstrating a contribution to knowledge using Gregor et al.'s publication scheme, especially as it is key to demonstrate an appropriate level of rigor (Hevner *et al.*, 2004) in such work. Gregor et al. (2013) address that challenge by proposing two frameworks to categorize scholarly articles by (i.) the type of knowledge contribution, and (ii.) the level of knowledge maturity (and hence abstraction). The frameworks provide three categories for knowledge maturity (ranging from "situated artifact instantiation" to "mature design theories"), and four categories of knowledge contribution types ("routine design", "improvement", "exaptation" and "invention"). Kuechler et al. (2012) published a framework to support the generation of intermediate design theories. They coined the term DREPT ("design relevant explanatory / predictive theory") to describe that type of theoretical knowledge. While providing a detailed framework to support theory generation from an epistemological and thus justificatory point of view, only sparse guidance is given on how to publish those results.

When designing innovative information systems in practice, many design decisions have to be made. Scholarly publications (should) ideally convey that design knowledge by extracting the essence of those innovative design factors. However, we found it hard to classify them into one distinct category of Gregor et al.'s frameworks (Gregor & Hevner, 2013). On one hand, as for any innovative system of real world complexity, not all design decisions are justifiable by existing prior knowledge (or have been decided upon consciously or intentionally at all). If all design decisions were completely justifiable by prior knowledge, it would not be possible anymore to contribute to scientific knowledge bases as no new knowledge could be added. Such designs would be categorized as "routine design" and would be unpublishable by definition (Gregor & Hevner, 2013). Thus, frameworks like (Kuechler & Vaishnavi, 2012) are not even applicable to portions of the design space, as the design knowledge is just to immature. On the other hand, based on our practical experience, it seems not even possible to fully describe the design for a class of systems within a single category of knowledge contribution or knowledge maturity. Knowledge contributions of real world systems are rather likely to fall into several (if not all) categories simultaneously. Some aspects of the system might be routine design (i.e. using existing platform libraries) while others might be transferred from foreign domains (exaptations) while still others might be improved versions of previously implemented constructs (improvements). A lack of clarity at this level could be a severe thread to the overall impression of the publication's rigor if not properly explicated.

A similar issue arises with communicating practical design knowledge on different levels of maturity. Gregor et al. (2013) have developed a hierarchy of maturity levels, ranging from "artifact instantiation" up to "mature theories". However, as we often face the need to describe whole classes of information systems, it is again unlikely for a publication to only transport knowledge at one distinct level of maturity. But apart from that practical aspect, presenting abstract and generic knowledge (like design theories) also requires the description of the actual instantiation of an artifact (Jones & Gregor, 2007). Therefore, even publications that cover very mature knowledge are also likely to present knowledge at lower levels of maturity at the same time.
Thus we see the need to express the type of knowledge contribution as well as its maturity on a finer level of granularity in a publication.

2.5.3 Maturing of knowledge within a DSR project's lifecycle

The design of innovative systems will always include a creative part of the designer (see Figure 29). Most likely, the creative part of the designer will be large when the project is novel and only little mature design knowledge is available. At any given time during a project's lifecycle, only parts of the design decisions can be justified through existing principles or (more mature) theories, while the rest is not (yet) formalized and thus can only be attributed to a designer's intuition (which equals intentionally taken design decisions) or is unconsciously made (which reflects the lowest level of maturity). One main concern of DSR is to formalize that "practical knowledge" (Goldkuhl, 2004) and thus transform the design knowledge into more mature forms. Gregor et al. (2013) describe those transformations in maturity level as "passive causal analysis", where the effects of unconscious design decisions unfold during the evaluation and "abstraction and reflection" as a process of transforming intentional design decisions into more abstract representations such as design principles. As DSR projects typically encompass several build/evaluate cycles (Hevner, 2007) design knowledge can mature with each iteration.

However, to present a complete picture of the state of knowledge within a certain domain, we therefore see the need for a structure that allows the publication of a snapshot of the design-knowledge at any given time in a project in order to comprehensively describe the artifacts design rationales.

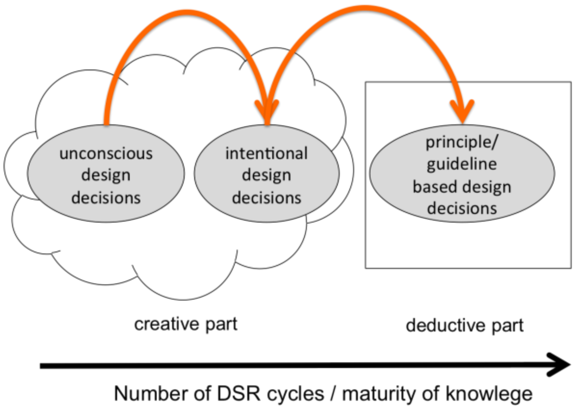

Figure 29: Flow of design decisions through maturity levels over time

Design principles as a way to encapsulate entities of design knowledge

To accomplish the task of encapsulating design knowledge of mixed levels of maturity and forms of contribution, we will use the concept of "design principles" as the primary format for formalizing design knowledge. At first glance, "design principles" seem to be a well-known and accepted form to convey design knowledge in design theories (Gregor, 2006). Gregor et al. acknowledge design principles as one way amongst others to communicate nascent design knowledge (Gregor & Hevner, 2013) as well as a corner piece of knowledge communication within mature design theories (Jones & Gregor, 2007).

Van den Akker (1999) offers the following generic structure of a design principle: "If you want to design intervention X (for the purpose/function Y in context Z), then you are best advised to give that intervention the characteristics A, B, and C (substantive emphasis), and to do that via procedures K, L, and M (procedural emphasis), because of arguments P, Q, and R." (Van den Akker, 1999). Depending on the nature of the design principle it may or may not be necessary to include both ABC as well as KLM. When the design principle focuses on process aspects KLM might be appropriated, where ABC may be more relevant when system features are to be described. PQR provide the grounding for the design principle.

However, this structure contains no explication of either the maturity level or the type of knowledge contribution per se. One candidate to operationalize the maturity level of a single design principle is its level of justification. For design principles used within design theories, Goldkuhl (2004) suggests different forms of possible justification which he termed "grounding" that helps justify "theorized practical knowledge". The four grounding strategies are displayed in Figure 30 and a short summary of each strategy will be given in the following.

Conceptual grounding: Conceptual grounding is adequately expressed when all the concepts and phenomena related to a prescribed action and its goals are precisely defined through definitions and reasoning (Goldkuhl, 2004).

Value grounding: For every prescribed action a clear reference to an addressed goal should be presented, and, at the same time, the measure of goal achievement must be described (Goldkuhl, 2004).

Explanatory grounding: Justification for the prescriptive statements can be given through the incorporation of abstract theories, for example, like "kernel-theories" (Goldkuhl, 2004). Kuechler et al. (2012) provide a detailed description of how those external theories are epistemologically related with prescriptive or explanatory statements.

Empirical grounding: Through empirical grounding (in terms of instantiation and evaluation of the prescribed action) it can be investigated whether or not the prescribed action works in practice (Goldkuhl, 2004).

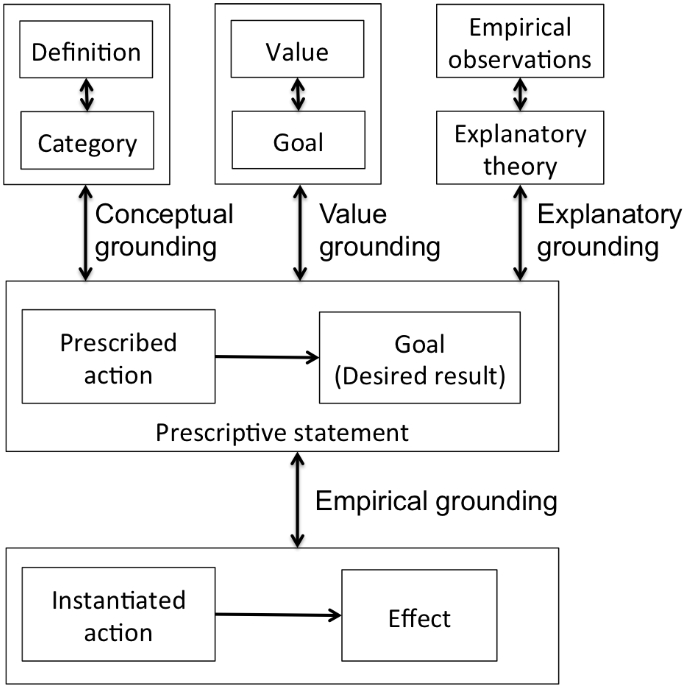

Figure 30: Grounding of prescriptive statements (Goldkuhl 2004)

As previously discussed, empirical grounding can be used to evaluate previously formalized design knowledge or give rise to completely new insights during the evaluation's execution (Gregor *et al.*, 2013). From an epistemological point of view these are different evaluation strategies. Pries-Heje et al. (2008) describe those different forms of evaluation for DSR projects in detail. An evaluation (in the sense of Goldkhul's empirical grounding) can only be of "ex-post" type, as the design principle has to be instantiated in the artifact to be testable. However, especially for multi-cycle DSR settings, the authors of (Pries-Heje *et al.*, 2008) acknowledge the same evaluation also to be of the "ex-ante" type with respect to subsequent evaluations. To avoid any confusion within publication of DSR results, we see the need to clearly explicate the epistemological type of evaluation used, especially if one evaluation is used as "ex-post" type to provide empirical grounding as well as "ex-ante" type to derive new insights within the same publication.

2.5.4 Method

For this article, the method of design science research is applied, too. We follow the methodological step described by Peffers et al. (2007) involving the following activities: (1) *Problem identification and motivation*, (2) *Define the objectives for a solution*, (3) *Design and development*, (4) *Demonstration*, (5) *Evaluation*, (6) *Communication*. In this article, we apply this methodology as follows: In the introduction section we motivate (1) the problem from a practical perspective and define the central solution objective of the artifact. After reviewing the existing literature associated with the problem, we derive the requirements for the artifact (which is, in our case, the publication scheme) (2). Based on the background literature we develop the publication scheme (artifact) (3). We demonstrate (4) the artifact's applicability by following the publication scheme's structure with one of our previously published scholarly articles. The artifact is evaluated (5) by demonstrating one successful application with the aforementioned publication and by logic argumentation (discussion section) of why that artifact solves the described problems. This article fulfills the purpose of communicating the results (6).

2.5.5 Developing the publication schema

To guide the development of an appropriate publication scheme, we first synthesize a set of meta-requirements (MRQs), summing up our initial practical problem discussed within the context of the related work:

MRQ1: *The publication scheme shall allow the simultaneous presentation of design knowledge at different levels of maturity.*

MRQ2: *The scheme should clearly explicate the type of the contribution as well as the level of rigor that is available for each contribution to design knowledge.*

MRQ3: *The scheme should clearly explicate the selection process for the design knowledge.*

MRQ4: *The publication scheme shall allow the presentation of design knowledge from both, ex-ante and ex-post, abstractions simultaneously.*

To express the rationales for design decisions within a DSR project, we propose the structure in. This structure emerged by combining the work of Walls et al. (1992), Goldkuhl (2004), Gregor et al.(Gregor *et al.*, 2013; Gregor & Hevner, 2013) and Kuechler et al. (2012). From top-down, and according to Walls et al. (1992), *solution objectives* (SO) should be defined for the whole socio-technical system in question. A clear argumentation of why that objective is important in a certain context is mandatory. Walls et al. suggest to define the class of problems the design theory addresses through the definition of meta-requirements for the artifact. We argue, that Walls et al.'s meta-requirements are just refinements to the solution objectives as defined before. Thus they should be derivable from them. This is expressed in Figure 31 by the use of dashed arrows representing the semantics of "derived from" to link *meta-requirements* to solution objectives.

Continuing our description of Figure 31 from bottom-up, we now focus on *the instantiated design decisions*. Gregor et al. (Gregor & Hevner, 2013; Gregor *et al.*, 2013) describe the different maturity levels for both, practical design decisions as well as for their abstract justification in the form of nascent theories containing principles or mature design theories. Kuechler et al.'s framework (Kuechler & Vaishnavi, 2012) promotes the different types of justificatory knowledge for a given artifact construction (meta-design). The interrelation of theory components and the other entities is represented by solid black arrows having the semantic of "justified by". "Unconscious design decisions" cannot be justified ex-ante by definition, as the designer was not even aware of them. However, they might still have an influence (represented by gray arrows) on the achievement of solution objectives.

Goldkuhl's grounding strategies (in particular value grounding) require a link between the principles (prescriptive statements) and the solution objectives (goals). However, as meta-requirements are already directly derived from the solution objective, they seem a good anchor point to which the value grounding should be attached to. The result is a directed graph (Figure 31) where ultimately for every design decision its contribution to a solution objective is traceable, thereby providing rigorous value grounding and also conceptual grounding by interrelating relevant concepts and phenomena within the shown hierarchy.

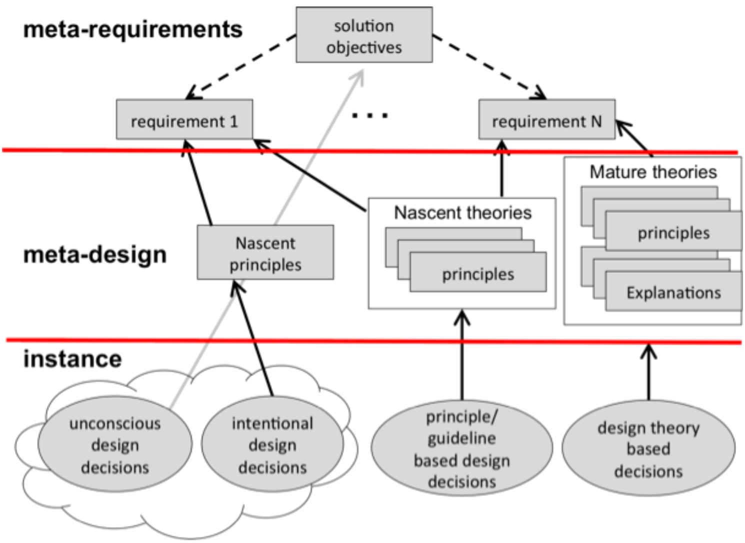

Figure 31: Structure of entities within an immature DSR project

The central focus of this article is to cover as much of the design knowledge as possible through the formulation of design principles. Therefore, it should be an objective to provide as much grounding as possible, even for the nascent principles created through abstraction (Gregor *et al.*, 2013) from intentional design decisions. Besides the grounding provided by the described structure, further conceptual grounding can be performed by describing the domain's constructs and phenomena, the system is designed within (Goldkuhl, 2004), in detail. To ensure solid conceptual grounding, all those constructs and phenomena need to be defined properly. Empirical grounding can be achieved by applying the design principles in the course of the artifact's construction. Design principles are instantiated through design decision in the artifacts. Depending on the design of the evaluation, it might or might not be possible to provide direct empirical evidence to single design principles. Often, all design principles are applied altogether and the system is evaluated in terms of its solution objective achievement. This clearly is the weaker (implicit) form of empirical grounding but it is still valuable as a global indicator of success. But through observations, made during the course of evaluation, it might still be possible to draw inferences to particular design decisions, especially when they have led to problems or did not work as intended. Explanatory grounding provides one of the most rigorous forms of grounding. Strong logic argumentation and/or the use of external theories (kernel theories) (Goldkuhl, 2004; Walls *et al.*, 1992) can provide the required justification level here.

To sum up the discussion on grounding a single (nascent) design principle, we propose the structure presented in Table 6 for the presentation of a multi-grounded design principle covering all described grounding strategies except of empirical grounding, because this requires the evaluation to have been executed.

Table 6: Proposed structure of a design principle

Section	Contents
1. Value grounding	Describe the requirement the principle should help to fulfill.
2. Conceptual grounding	Make clear how the constructs used within the design principle interrelate with the domain objects. Clearly define any constructs not jet described.
3. Explanatory grounding	If possible, provide explanations why the design principle should work in theory. Either justify the principle by logic argument or reference existing knowledge (maybe kernel theories) presented in the background section.
4. Prescriptive statement	Precisely formulate an action that is applicable in the artifact's design.

2.5.6 Proposed adapted publication schema

To give practical advice on the publication of nascent design theories through design principles, we consolidate the previous aspects discussed into one publication schema. The aim was to merge the developed structures (Figure 31 and Table 6) into an existing, accepted and often cited publication scheme. The resulting scheme is an adapted version of Gregor et al.'s generic template for DSR publications (Gregor & Hevner, 2013) which has been extended (formatted in italics) to integrate the previously discussed constructs:

Table 7: Publication scheme adapted from Gregor et al. (2013) (Extensions and refinements are formatted in italics).

Section	Contents
1. Introduction	Problem definition, problem significance/motivation, introduction to key concepts, research questions/objectives, scope of study, overview of methods and findings, theoretical and practical significance, structure of remainder of paper. *Definition of the solution objectives (SOs) the intervention strives to achieve with a link to already described problems. The research gap should also be given here. An outlook to the scientific contribution that emerges should be given as an outlook for the paper's discussion.*
2. Literature Review	Prior work that is relevant to the study, including theories, empirical research studies and findings/reports from practice. *If existing design-principles or design theories are used, they have to be referenced here. As a conclusion of the literature review section, the gap in current literature should be stated.*
3. Method	The research approach that was employed.
4. Communication of design knowledge	*1. Meta-Requirements (MRQs) for the artifacts with clear reference to the SOs.* *2. A list of synthesized design principles (DPs) following the structure proposed in Table 6. For each DP, its instantiation in the artifact should also be described here.* *4. Representation of the artifact as a whole as good as possible (screenshots of software, photographs of the environment it is supposed to be used within, etc.)*

5. Evaluation	*Presentation of the evaluation results. Presentation of data to support or reject the fulfillment of the SOs. If data is available to support or reject individual DPs it should be presented here.*
6. Discussion	*1. Epistemologically close the loop between the sum of the design interventions and the achieved objectives.* *2. If data (observations) are available that allow inferences on more detailed levels, link them back to MRQs or DPs whenever possible. If some of the design interventions did not work as intended, give possible explanations and point out further research opportunities.* *3. If the evaluation motivates new design principle or refinements to previous ones (through the process of passive causal analysis* (Gregor *et al.*, 2013)*), derive new potential design principles (or refinements) here following the same structure as proposed in Table 6. Of course in this case, empirical (ex-post) empirical grounding cannot be provided but may be subject for further research.*
7. Conclusion	Concluding paragraphs that restate the important findings of the work. Restates the main ideas in the contribution and why they are important.

2.5.7 Application

To demonstrate how the publication schema could be applied in practices, we analyze one of our previous scholarly articles (Heinrich, Kilic, Aschoff, *et al.*, 2014) that followed this structure. The article covers the topic of interpersonal relationship building when IT artifacts are collaboratively used in a dyadic setting. It communicates the results of a multi-cycle DSR project in the financial sector. In particular, that article contributes meta-requirements and design principles for IT-artifacts supporting interpersonal relationship building in financial advisory service encounter. As the research was carried out in a two-cycle DSR process, the scheme was slightly adapted to present the results in a cohesive manner. We will shortly discuss the structure of the article along the sections of the extended publication scheme (Table 7):

Introduction: In the introduction we briefly motivate the necessity to understand relationship-building in technology supported service encounters. A research question is formulated accordingly and a very rough outline of the paper is presented. Furthermore, the cyclic DSR setting is outlined and the specific structure of this DSR project is sketched as: build-evaluate (prototype 1) → abstraction & conceptualization → build/evaluate (prototype 2). As in this case the solution objective is justified by the empirical findings originating from the first evaluation, its presentation has been shifted to the "Communication of Design Knowledge" section.

Literature review: The relevant literature covering the role of IT-artifacts in advisory encounters as well as literature covering relationship building in face-to-face collaboration is presented here. The design and primary evaluation of the first prototype was presented (in a seperate section) directly after the literature review part, as it was already published. However, for the purpose of that publication, the original evaluation of the first prototype was extended by the (previously unpublished) results regarding the failed relationship building aspect.

Communication of Design Knowledge: This section was split into two parts (meta-requirements / meta-design & instantiation) to ease the reading. In a first step, the solution objective of the artifact was presented: "Establish effortless relationship building in IT supported face2face advisory encounters". From there on, the (meta-) requirements are derived from three sources: existing literature, observations during the first evaluation, and a newly developed model of failed relationship building attempts. The derived requirements covered the design artifacts software, physical setting (environment), and process (organizational structure). Five meta-requirements were presented. One sample meta-requirement (originally called generic requirement in that article) governing the environmental aspects was: "*The physical effort to switch into the relationship building space has to be low. Avoid the need for body movement at all.*" For each requirement, justification was given by means of referencing existing literature, the developed model or the evaluation observations (notably the first evaluation which was treated as an ex-ante evaluation).

In the meta-design & instantiation part, design-principles were presented and their instantiation within the artifact was described. Every design principle references at least one requirement and thereby provides value grounding. We strived for proper conceptual grounding by assuring that all constructs and entities were explained in the previous sections. Explanatory grounding was given in the form of logic argumentation. One sample design principle was: "Design-Principle 3 (to address generic requirement 3 and 5): Place the participants on adjacent sides around the table so that the RBS and AWS are reachable with minimal body and head movement. "[3]. Through the reference of the requirements value grounding is provided. To provide explanatory grounding, the relevant literature in the "literature-review" section is referenced directly with the design principle. To prepare the empirical grounding, explanations on the specific instantiation is given directly after the description of the principle: "[…] we raised the table by 15 cm to a comfortable height of approx. 70 cm. This allowed the participants to sit in a slightly tilted, diagonal position and use the table as an arm rest […]. "

Evaluation: The evaluation contained a qualitative part of observations and interviews made with the participants as well as a quantitative measure of

[3] RBS and AWS are abbreviations of two (physical) states, participants could be within. Either a person works on the artifact (AWS) or he engages in relationship building (RBS) by seeking eye contact with the other person.

relationship building. Relationship building was operationalized indirectly by the time the participants mutually face gazed. From video recordings of the settings the gaze durations were sampled and compared between the two prototypes.

Discussion: In this section the results were discussed with respect to the overall solution objective as well as with respect to the previously defined requirements. We could demonstrate that the prototype, with our design principles implemented, could meet the solution objectives. However, *a rigorous empirical grounding for individual design principles could not be achieved with the evaluation design used, as discussed in the limitations section.*

2.5.8 Discussion and conclusion

By applying the presented publication scheme, and its inner structure of the design principles to scholarly publications, we can address the practical problems discussed in the introduction. The problem of mixed knowledge maturity levels vanishes, as the scheme foresees design principles to communicate design knowledge, which can be formulated at all levels of maturity. The maturity of design principles can be explicated by their degree of justification, thereby not threatening the overall impression of rigor for the whole publication if only some design principles are immature. If all grounding strategies are successfully instantiated for all presented design principles, strongest rigor is demonstrated at this level. The selection of requirements for publications now follows a clear process: A requirement is included within a publication if design decisions (which are prescribed in the form of design principles) address it and at the same time the requirement is derivable from one or more of the presented solution objective. The structure explicitly foresees the communication of ex-ante and ex-post knowledge creation, while being always transparent on the rigor, and, thus, also on the maturity level of the communicated knowledge.

As we have shown in this article, it is likely for any practical DSR project to incorporate design knowledge on different levels of maturity on the meta-design level. However, also on the meta-requirements level, knowledge of different maturity levels can be incorporated. In the case of this article, the meta-requirements are derived form practical problems and gaps in the current literature. All meta-requirements address the central solution objective to “foster the publication of nascent design knowledge in scholarly publications”.

From a DSR perspective, this article can also be seen as a nascent design theory by itself. This article provides central design principles on how to publish nascent design theories. The statement “Use the proposed structure in order to publish design knowledge” is prescriptive in a way that it suggests an action and formulates the desired goal. We provided proper grounding throughout the article by applying the described grounding methods: First, by a clear introduction of the relevant concepts based on existing literature. Second, conceptual grounding was provided for all relevant constructs used in the publication scheme. Third, value grounding was achieved by describing a desired goal, motivated by practical problems, and why that goal is important to the community. Fourth, only little explanatory grounding is provided, as it would involve theoretical models of how the publication process within the scientific community works and why. Most reasoning for the structure and constructs within the scheme are therefore of “conceptual grounding” or “value grounding” type. Empirical grounding is provided in the form of “proof by construction” (Nunamaker Jr & Chen, 1990) (also mentioned in Hevner, 2004), as we presented one article that we could published with that structure applied.

Nevertheless, the empirical grounding in this article has to be treated as ex-ante evaluation because a large empirical base of published (or rejected) articles is still missing. Hence the design knowledge communicated within this article is at an intermediate maturity level and further research might be necessary to provide stronger (i.e. empirical) justification as well as refinements and adaptions to the described publication schema following the spirit of DSR as a "search process" carried out by the community.

In this paper we have discussed several practical writing problems of DSR related articles. By reviewing publication guidelines found in current literature, we identified a lack of specificity to describe design knowledge of practical DSR projects. Based on the literature on the concepts and methods of design research we derived a conceptual framework to arrange the knowledge entities within a publication (Figure 31) in order to foster "conceptual grounding" (Goldkuhl, 2004) and "value grounding" (Goldkuhl, 2004) within those publications. The central entities of that schema are design principles as a way of formalizing design knowledge as prescriptive statements. We then applied the notion of multi-grounding from Goldkuhl (2004) to express the maturity level of a single design principle in terms of its "degree of grounding". To anchor those multi-grounded knowledge descriptions within a publication schema, we extended an existing scheme (Gregor & Hevner, 2013). As a first instantiation, we could present one scholarly article that has been published following the prescribed structure. Hence, with this article we contribute a publication scheme that addresses our practical publication problems by providing a step-by-step guideline to publish design knowledge at any level of maturity and in any stage for practical DSR projects on innovative IT artifacts.

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